THE UNIVERSITY OF QUEENSLAND

Updating and Maintaining a Quality Control Plan

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Executive Summary

Automotive manufacturing is growing in complexity due to the increased demand for market dominance based on customer modification options. Increasing the level of modification within a product can have negative effects on the outcome if not managed effectively. The changes enforced through variations in design require altering quality requirements dependent on the required process. Through the implementation of quality control and quality assurance principles, these changes can be managed. A primary strategy in the control of quality requirements throughout manufacturing is the implementation of a control spreadsheet. Also known as a quality control plan, this document includes the answers to the following questions when it comes to quality control.

- What is being controlled
- How it is being controlled
- Who is in charge of this control
- Where is the control occurring
- What is the frequency of when checks are required

Throughout the project, the formation of a quality control plan template has been completed based on the analysis of previous editions along with a literature review into the required aspects of a control plan. Whilst the template was completed in the early stages of the project, feedback gathered throughout has led to changes in the template to increase the useability of the document. With the template finalised, the control plan has been populated with all the required controls for the desired operations with only the tooling category requiring completion in conjunction with another ongoing project.

In order to ensure this is maintained, an implementation strategy has been formed through the use of an IDEFo process layout. This layout provides all the necessary information regarding inputs, controls, mechanisms and outputs required for each activity. Through the use of this system, the management principles between total quality management (TQM) and configuration management (CM) can be integrated into the process and thus into the Wacol facility.

In regards to automation, it was found that due to the complexity in the systems currently in use, an entire overhaul of new systems would be required to enable automation. As such, the idea of automation has been amended to focus on processes including the creation, assigning and completing of tasks rather than the information flow. With the implementation of this automation system, the TQM and CM processes and the quality control plan document, the operations requiring controls will be able to be successfully traced and referenced.

Acknowledgements

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Also from the University of Queensland, I would like to thank my academic supervisor, Professor Peter Knight for the invaluable knowledge that has been provided into a new aspect of engineering in which I previously had no experience. I would also like to thank Professor Knight for the time he has taken to provide feedback on previous reports in the progression towards this final thesis.

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1.0 Introduction

1.1 Background information

Volvo Group is a global company involved in the manufacturing of trucks, buses and construction equipment, along with marine and industrial engines (AB Volvo , 2019). Included amongst facilities located all over the world is the Volvo and Mack truck manufacturing plant at Wacol (figure 1). Involving a high level of complexity and large volumes of inputs, the Wacol facility requires an in-depth system of controls to help monitor production. With over 70% of trucks produced having customised features the level of customisation at the Wacol facilities ensure Volvo and Mack trucks remain a fierce competitor in the automotive industry with an average production rate of 18 trucks per day (AB Volvo, 2019).

Figure 1: Wacol Facility (AB Volvo , 2019)

Due to the large volumes and complex products being produced, Volvo requires numerous systems to ensure processes are followed. One major issue that is currently faced through the use of multiple systems is traceability when it comes to quality control. As such, a quality control plan is necessary to ensure all controls are correctly referenced and implemented throughout the factory. A quality control plan that accommodates for multiple systems and is able to be maintained for an every changing industry will not only benefit the production of the vehicles, but also help to increase customer satisfaction through reduction in defects inevitably increasing business opportunities.

2.0 Technical Background

In today's competitive automotive market, the need to provide an edge over competition has become harder to come by but more necessary. Companies are leaning more towards a largely customisable based model providing customers with variations to suit their requirements (Johansson, et al., 2016). However, with the number of variants increasing, adverse effects can be had on the production and manufacturing of products in the form of efficiency and quality issues (Elmaraghy, et al., 2013). Products are requiring more specified methods of assembling and testing which increase the complexity of the manufacturing process (Johansson, 2016). As such, adaptive quality methods are required to be introduced to accommodate for the dynamic and fast-paced nature of the manufacturing process.

2.1 Review of fundamental principles

Quality management is the process that incorporates the planning, control and improvement of systems in place regarding the manufacturing of a product through its lifespan (Juran, 1992). Used in some way in all industries to ensure customer satisfaction, quality management can be split into three main aspects:

- Quality assessment – quantitative criteria to be checked
- Quality control – how defects can be detected through focusing on how procedures fulfil quality requirements
- Quality assurance – determination of the prevention of defects through focusing on processes that provide confidence ensuring quality requirements are fulfilled (ISO 9000, 2015)

In the implementation of these principles, a 6σ quality management system can be incorporated into a company. As part of the 6σ quality management system, Plan-Do-Check-Act model (PDCA cycle) can be used to implement continuous improvement (Westgard & Westgard, 2015). A major tool in the implementation of quality control and continuous improvement into a workplace is through a control spreadsheet or control plan (Juran & Godfrey, 1999). Part of a PDCA cycle, the control plan acts as a governing document, providing information on the controls put in place in order to ensure quality requirements are completed to the necessary criteria. With the complexity in design and manufacturing in industries increasing, incorporating a control plan with quality assurance processes – auditing, inspections and testing – can help to ensure products are manufactured to a high quality whilst not decreasing in efficiency. In conjunction with other quality management tools (FMEA, PFMEA etc.) this will allow companies to continue providing customers with high levels of customisation without being detrimental to the product.

2.2 Relevant literature

Quality assurance ensures the benchmarks and requirements are met when progressing through development and into circulation. Commonly consisting or different auditing scenarios and multiple checks throughout production, quality assurance has proven to be a vital concept to be implemented into multiple industries (Hiraishi, et al., 2000). There are currently numerous processes in place throughout different industries implementing control and assurance strategies. Each process provides in-depth quality control or assurance throughout the lifespan of the product. In regards to the automation of a process for implementing and maintaining quality methods, the four that will be focused on are: total quality management, quality control plan, configuration management (CM) and an automation process based of the principles of process management systems such as IDEF0.

2.2.1 Total Quality Management

Total quality management (TQM) is a system originating in Japan that focuses on the improvement of organisational aspects to increase the customer satisfaction levels and improve competitiveness throughout respective industries (Arditi & Gunaydin, 1997). Consisting of the components seen in figure 2 to the right, TQM aims investigate ways to continuously improve the quality and productivity throughout production. This is achieved through the following of certain quality management systems including the PDCA cycle as previously stated.

Figure 2: Components of TQM

Successful management of all these aspects will help to ensure that the investigations into continuous improvement are managed correctly and strictly follow the required process (Powell, 1995). However, the implementation of TQM into a workplace is not a simple project. It requires a change in management principles to adapt to the dynamic industry and fluctuating customer expectations (Kanji, 1995). As such, it is necessary that any control component being implemented is able to be adaptive to a TQM framework.

In order to ensure any new component is adaptive to TQM a complete breakdown of the core concepts of TQM is required.

Table 1: In-depth analysis of TQM concepts

TQM Concept	Requirement
Leadership	• Participation and encouragement from top management • Regular meetings providing resources for necessary quality improvements
Management of People	• Regular quality education and training • Active involvement in quality-related activities
Customer Focus	• Channel for information regarding customers • Attention payed to customer complaints from all levels of employees • Feedback is gathered from customers on a regular basis
Use of information and analysis	• Information gathered from all departments • Methods used to implement new designs • Regular audits of quality plan and policies • Evaluation of departments conducted using quality related data
Process improvement	• Quality inspections implemented effectively • Employees have access to process improvement suggestions
Strategic and quality planning	• Policies and plans clearly readily available to employees • Highlighted quality goal in place • Policies and plan revised ensuring effectiveness is maintained

(Li, et al., 2003)

Incorporating these concepts into quality control programs will help to improve the processing, product and service quality throughout all areas of the company. One such program that is required in order to help in TQM is an adaptive quality control plan.

2.2.2 Quality Control Plan

A quality control plan is an adaptive document that provides governing requirements over processes in the workplace. Enforcing ways of testing and inspecting, the control plan determines how to detect defects that could increase the risks and undesirable effects of a completed product. The plan aims to:

- Address risks and opportunities
- Integrate and implement actions (ISO 9001, 2015)
- Provide benchmark to evaluate effectiveness

This is achieved through the implementation of a Plan-Do-Check-Act (PDCA) cycle where the plan stage is a direct link to the control plan. The quality control plan should include answers to the questions of: what is being controlled, how it is being controlled, who is in charge of this control, where is the control occurring and what is the frequency of when checks are required (Parasyuk, 2012). In regards to a manufacturing setting, these answers should include but not be limited to the following:

1. Latest Change
2. Description of part/process
3. Core team responsible
4. Operation Description (Quality One International, 2015)
5. Machine/Device/Jigs/Tool for manufacturing
6. Special characteristic classification

In order to ensure the control plan includes all necessary information, an analysis of relevant documents including technical regulations, standards, drawings and legal documents must be completed. Another important aspect of the control plan is the process in place to maintain and update according to changes in the workplace, as per the TQM concepts (Hiraishi, et al., 2000). This could be due to new processes, new personnel or new requirements. A system must be introduced to ensure this is done efficiently and effectively.

2.2.3 Configuration Management

Configuration Management (CM) is a communication and coordination process that ensure changes made throughout an organisation are traceable and the quality requirements are followed. The main aspect of CM that will be focused on is its ability to address any implications caused by technical change and provide approval as to how the quality of this change will remain controlled. This is monitored through an investigation into four specific requirements (Fowler, 1996):

1. Customer's requirements are satisfied through new design
2. Change in design is controlled
3. Design change is implemented into corresponding build area
4. All design documentation and resultant outcome is reported

CM works through the understanding of its three main aspects: baselines, activities and people. These are broken down in figure 3 below and form the foundation for CM (Phillips, 1996).

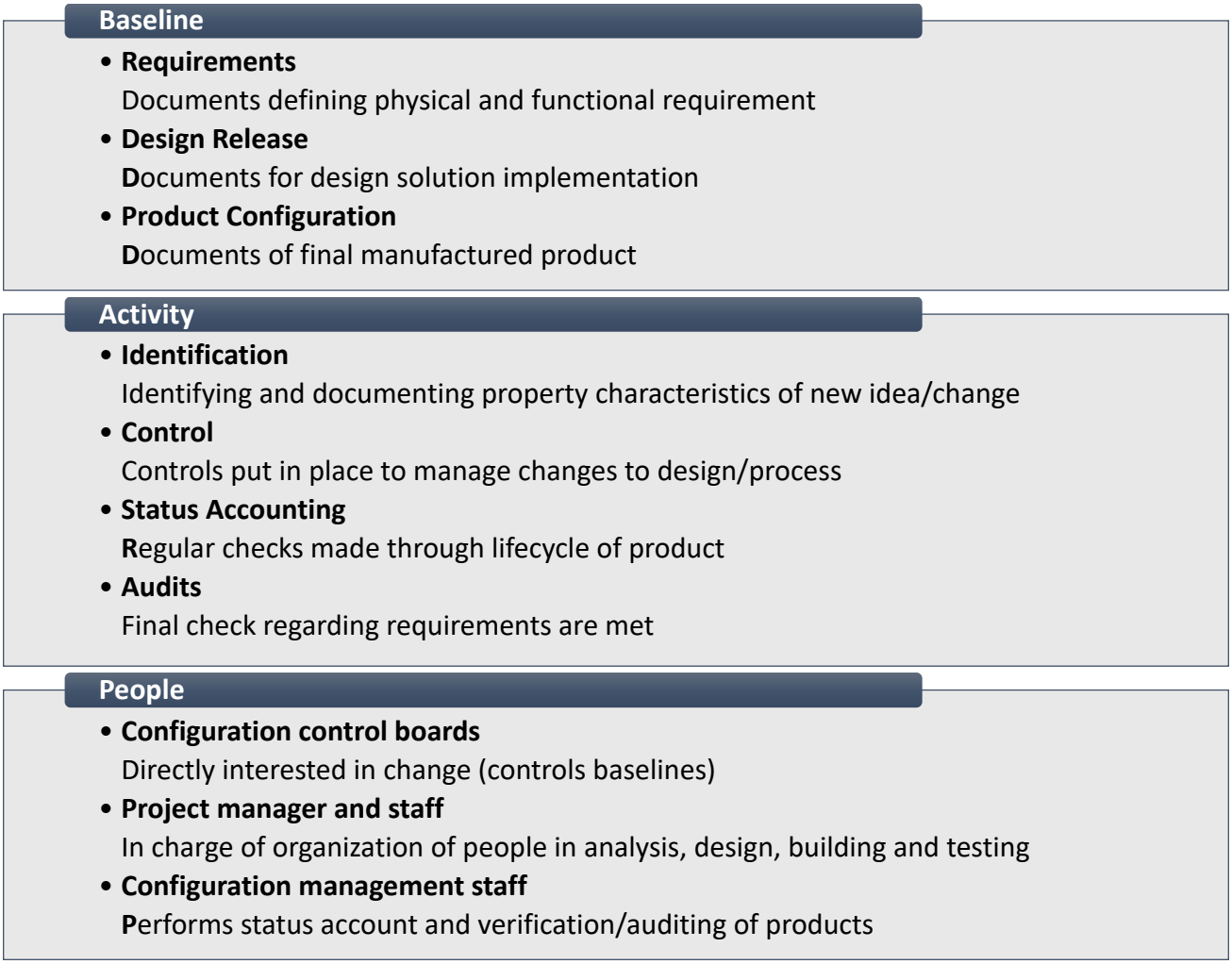


Figure 3: Aspects of Configuration Management

To ensure configuration management is successfully implemented into a working environment, there are some critical safety factors that must be taken into account. These are: executive strategies, decision maker, performance monitoring, sufficient resources, effective environment and communication (Ali & Kidd, 2014).

1. **Executive Strategies**

It is important that the process of CM doesn't defer from the current vision and policies within a workplace. This may limit the effectiveness of CM however in order to succeed within a company, alterations must be able to be made to the CM plan to fit with the current controls and processes.

2. **Decision maker**

In order to successfully implement CM, a competent decision maker must be considered when it comes to management support. This will provide leadership and insight into how CM is best implemented.

3. **Performance Monitoring**

Although, in theory, CM will increase the efficiency and quality throughout a workplace, it is necessary to continuously monitor the progress of implementation and improve where required. This will ensure the system remains up-to-date with the most effective process to ensure successful changes in operations.

4. **Sufficient Resources**

With CM being a heavily resource driven system, there is a necessity to ensure all resources are trained in accordance to processes involved with CM. It is also necessary that there is an adequate number of resources available.

5. **Effective Environment and Communication**

Engagement with stakeholders is important in many aspects of configuration management. Whether it be through the providing of feedback or requirements from customers or the ease of operation for workers, CM needs to consider all parties and ensure solutions are obtained that help all involved.

In order to implement configuration management, a configuration management plan must be followed. This plan is a governing document that includes details surrounding all of the above information listed. This should act as a binding document to be referred to whenever issues arise from implementations. This plan includes:

- Introduction – overview of purpose, scope and description of products involved in the process
- Policies – necessary clarification of responsibilities and terminology used throughout the plan
- Configuration Identification – identification and documentation of characteristics for new ideas
- Configuration Control – processes in place to control new changes
- Configuration Status Accounting – check made throughout lifecycle of the product
- Configuration Audit – final check ensuring customer requirements are met

(ISO 10007, 2017)

If all these critical factors are considered and the activities presented are following, configuration management can have an important impact to the operations in an organisation and provide the organisation with the following benefits (Knights & Wilcock, 2019).

- Single database including all data and records required for design changes and review procedures
- Identification and documentation of all products
- Controlled changed displaying approval process
- Traceability for all products

A case study into the implementation of configuration management into the shipbuilding industry found that not only could CM increase the quality of manufacturing processes but it could also prove helpful in the reduction of waste in manufacturing. This would help to increase the efficiency of production (Fowler, 1996). The next stage of ensuring changes are kept up-to-date and efficiency is maintained is to automate the quality control process.

2.2.4 Automation in control (product and process) and IDEFo

In order to track changes and implement new control methods/requirements, a system must be put in place. Configuration management can help with the communication and traceability of changes however this is primarily a manual system. Automation of control systems will allow for increased efficiency and understanding, if implemented correctly, however could be detrimental to processes if the wrong type of automation is introduced. In regards to quality, there are multiple packages that can be implemented to benefit the changes throughout manufacturing. This automation can be split into two aspects: concepts and practice. These aspects influence how the manufacturing processes are conducted through computer assisted management packages (concepts) and the actual hardware and software used to base the strategies of automation around (practice) (Tannock, 1990).

Systems currently in place that can help with automation of quality control include:

- Computer integrated management
    - Ability to hold and maintain required information for individual operations performed throughout manufacturing process
- Computer aided inspection (Zhao, et al., 2009)
    - Inspection stations are fitted with a computer which is used to guide operators through quality assessment
    - Results from quality checks are recorded and saved in database
    - Provides live updates on issues that are found throughout production

Whilst the above two systems focus primarily on the quality control throughout the workplace, there is still a need for an additional system for change control (Mayer, et al., 1992). This can be based upon a format called, IDEFo – Integrated computer-aided manufacturing (ICAM) definition. The IDEFo system is based around the fundamental relationships required to complete a decision, action or activity in a process (Mayer, et al., 1992). This relationships are portrayed in a clear process flow through activity boxes such as can be seen in figure 4. As can be seen, each activity has multiple relationships. These being:

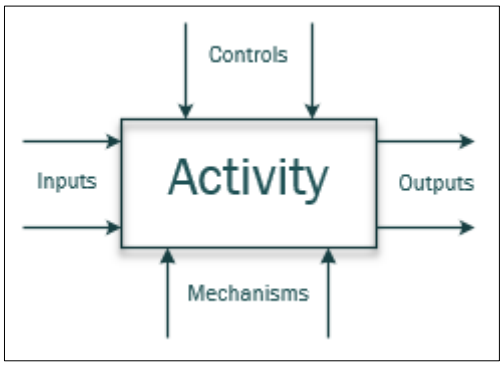


Figure 4: Individual IDEFo process block

1. Inputs – required to be inputted to complete the activity
2. Outputs – result of the completed activity
3. Controls – restrictions enforced included technical documents and standards
4. Mechanisms – resources required to complete activity (Inc. people, machines, software etc.)

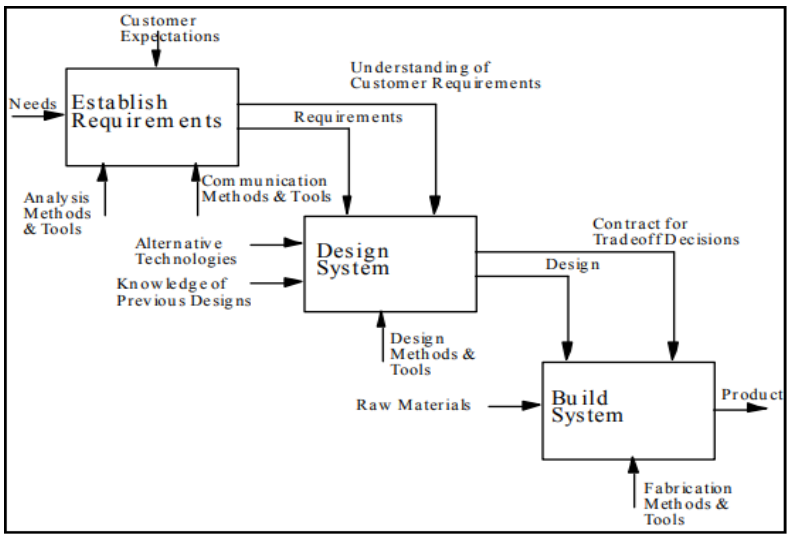


Figure 5: Complete IDEFo Process Example

Through completing a network of these activity blocks, a complete process can be illustrated. The IDEFo system not only provides a clear outline of the process involved in an operation, but also can help to determine issues in current/future processes such as possible bottlenecks or incorrect allocation of resources.

2.3 Summary of relevant literature

After a more in-depth literature review was conducted, it was found that the implementation of any quality control system will require cooperation from all levels throughout an organisation and should follow the principles behind Total Quality Management. Although configuration management may be the most effective way to handle a dynamic environments, it can be quite difficult to introduce to an organisation. It can however, provide suitable traceability to the criteria included in a quality control plan. Through the use of a processing system such as IDEFo, the method of implementing configuration management into the operation of maintaining a quality control plan can be clearly portrayed with all inputs, outputs, control and resources being identified.

In regards to automation, it was found that software would require specified systems in operation in order to be successfully implemented. These include: specialty worksites with computer capability and singular databases incorporating all necessary information.

3.0 Project Description

3.1 Goals

This project aims to introduce a quality control plan into the Wacol manufacturing facility that is to be maintained and used in the creation of quality assurance criteria and control instructions. The primary goal is the creation of a live document that will be a governing piece of material used throughout the factory. This will be accompanied with an implementation and delivery plan to ensure the plan is able to continue being used, independent of the person/people who are in control of the document.

An additional aim of this project is to research and develop an automated system that will be able to control the quality assurance document throughout the factory. It has been proposed that although this isn't the main goal, the viability and possibility should be investigated with a desired solution being formulated for proposal in the future.

3.2 Scope

In order to complete the project goals stated above, a project scope must be made clear and followed. The following table displays what considerations are and aren't included in the scope.

Table 2: Scope definition

In Scope	Out of Scope
Updating of quality control points through • All Engineering documentation	Updating of software currently used throughout the factory (Sprint, KOLA and AS400)
Research conducted into automation	Consideration of factories/production lines outside the Wacol facility
Following of a project management strategy	Development of new techniques to improve quality within production/design
Investigation into ways to link tooling, instructions and requirements	Consideration of any external model's production/modification
All critical characteristics (CC) and special characteristics (SC) instructions	Investigation into tooling options for control points
Production lines for both Mack and Volvo products (Wacol facility only)	Follow-up stage of the project management
Creation of an adaptive control plan with implementation into the Wacol facility	

3.3 Deliverables

The deliverables for this project can be broken down into two categories: company based and university based. The first of these, company based, corresponds to the objectives that must be met to ensure the project within the company is completed.

- **Control Plan**
  - Template formed and updated with all necessary critical characteristics and special characteristics
  - Tooling, quality control and item/variant information updated as per most recent technical documents
  - Systems are successfully linked within the factory processes

- **Meeting Minutes**
  - Final meeting minutes with stakeholders regarding the acceptance of the control plan to be implemented throughout the factory

- **Presentation on the control plan**
  - Explanation on what has changed about the new control plan
  - Cost-benefit analysis comparing old and new method
  - Production flowchart illustrating operations required according to new method
  - Results from investigation as to how this project will be useful for the company

- **Delivery Plan**
  - Instructional document illustrating how to maintain and update the control plan
  - Process to follow the ensure the plan is continuously improved as per TQM principles

In regards to the university deliverables, these consist of:

- **Project Plan** – initial document stating the proposed outlay of the project
- **Interim report** – secondary document extending upon the project plan with a more in-depth investigation into the progression of the project
- **Final report** – revised version of the interim report consisting of critical analysis of results or outcomes obtained by the completion of the project

4.0 Project Methodology

As part of the project, it is important to consider both the company and university deadlines. As such, an activity plan has been constructed to ensure the project was on track for all concerned parties. This activity plan followed the structure of a project management system called PSM (project steering model) used throughout the Wacol facility. This plan includes:

- Identification of resources required and milestones
- Communication strategy illustrating how resources will be kept informed and input obtained from necessary stakeholders
- Timeline of current progression and future deadlines
- Risk analysis including both physical, software and mental implications that may arise

4.1 Activity plan

There are three main stages that can split up this projects life-cycle: feasibility study, development and fulfilment.

4.1.1 Resources

Throughout each of these stages, there are differing levels of involvement that is required from some resources due to the nature of the task at hand. As previously discussed, this project is heavily resource dependent and as such it is necessary to break down the amount of time required from each of the available resources. Due to the project involving heavy implementation across different department, resources from the following are required.

Table 3: Resources from various departments

People	Software or Location
Process/Production engineering	KOLA – Volvo item/variant database
Quality process technicians	Sprint – instruction and control database
International quality team	Microsoft Office – primarily excel
Assemblers	Citrix – document viewing software
Sprint “super-users”	Production lines
Quality assurance engineering	

The level of involvement for each of these resources as the project progresses can be seen in tables 3 and 4 on the following page. All resources how been included in a communication plan to ensure communication is maintained throughout the duration of the project. This can be seen in appendix A.

Table 4: Resource involvement - People

Resource - People						
Phase	Process/Production Engineering	Quality Process Technicians	International Quality Team	Assemblers	Sprint "super-users"	Quality assurance engineering
Feasibility Study	**Low**	**Heavy**	**Low**	**Low**	**Low**	**Moderate**
Project Development	**Moderate**	**Heavy**	**Low**	**Low**	**Low**	**Heavy**
Project Fulfilment	**Heavy**	**Heavy**	**Moderate**	**Heavy**	**Moderate**	**Heavy**

*Note: Cells are level of involvement

Table 5: Resource involvement - Software and Location

Resource – Software and Location					
Phase	KOLA	Sprint	Microsoft Office	Citrix	Production Lines
Feasibility Study	**Heavy**	**Heavy**	**Heavy**	**Heavy**	**Low**
Project Development	**Moderate**	**Heavy**	**Heavy**	**Moderate**	**Moderate**
Project Fulfilment	**Moderate**	**Moderate**	**Heavy**	**Low**	**Heavy**

*Note: Cells are level of involvement

4.1.2 Milestones

The milestones put in place for this project will help to ensure tasks are completed by the required date and stakeholders are kept informed with the progress throughout the duration that the project is undertaken. The main milestones to be met throughout this project are in the form of gates. These gates consist of a presentation to committee members that will provide the agreement that the project is on track and can be continued to the next stage. There are six throughout the lifespan of the project being:

1. Feasibility Gate – 01/02/19
2. Development Gate – 22/03/19
3. Investment Request Gate – 03/05/19
4. Industrialisation Gate – 24/05/19
5. Trimming in Gate – 14/06/19
6. End Gate – 28/06/19

These milestones have been interlinked with the deadlines for university reports to ensure both aspects of the project are kept in relation to one another.

4.1.3 Project Approach

Throughout the progression of the project, it became apparent that there was a clear separation between the required tasks. These were: updating the control plan and then a strategy to maintain the control plan. As such, two different approaches had to be taken, one for each task.

4.1.3.1 Maintaining

In order to ensure the activity plan follows a structured process, the stages listed on the following page must be followed. Each stage is assigned a timeframe, what is involved and individual deliverables to present before progressing to the next stage.

Table 6: Project Approach to maintaining aspect

Week/s	Activity	What will it involve?	Deliverables
1 – 3	Training Exercises	1. Understanding of systems currently in place along with all necessary software requirements 2. Attending of factory induction training sessions including OH & S 3. Introductions to stakeholders in the project	1. Completion certificate of training courses for software packages
4	Project Directive	1. Overview presentation of project to committee members 2. Investigation into the resources, time and tasks required to be completed	1. PowerPoint slides to be sent out the day before presentation for members to review and prepare for presentation
5 - 10	Feasibility Study	1. Research into possible ways to implement and maintain the control plan 2. Meetings with stakeholders 3. Research into automation possibility 4. Previous template analysis and future proposal	1. Breakdown of current control plan document outlining features of previous templates 2. Template of control plan to be used in other part of the project (updating) 3. Process flow of plan to update the control plan 4. Presentation providing the results of research into strategies to implement and maintain the control plan 5. Presentation providing the results of research into possibility of automation of the process

11 - 18	Development	1. Establishing approved plan based off results from Development Gate meeting 2. Determination of required resources to fulfil the plan 3. Analysis into require funding if necessary	1. Business case for funding if necessary 2. Presentation to stakeholders based on business case if required
19 - 21	Final Development	1. Continuing development of approved plan 2. Meetings with all stakeholders 3. Increased interaction with production line and process engineers	1. Draft of complete control plan 2. Process flow to updated control plan 3. Implementation plan
22 - 23	Industrialisation	1. Rollout of implementation plan on initial test section of production 2. Verification and validation that the plan is clear and able to be used effectively	1. Results for testing area 2. Feedback from production and quality regarding effectiveness of control plan
24 - 26	Trimming-in	1. Final implementation into the factory 2. Final meetings with stakeholders regarding possible improvements and hand-over information	1. Meeting minutes for the hand-over of project to production 2. Final implementation plan 3. Maintaining process plan

4.1.4 Project Approach – Updating

The other part of this project is the updating of the control plan. This involves looking through all types of engineering documents (drawings, TechNotes, technical regulations etc.) to determine the requirements to include in the control plan. In order to ensure nothing is missed whilst completing this check, a process is required to be followed.

This process was formed on the basis that the training exercises are completed and understanding of the necessary software has been obtained.

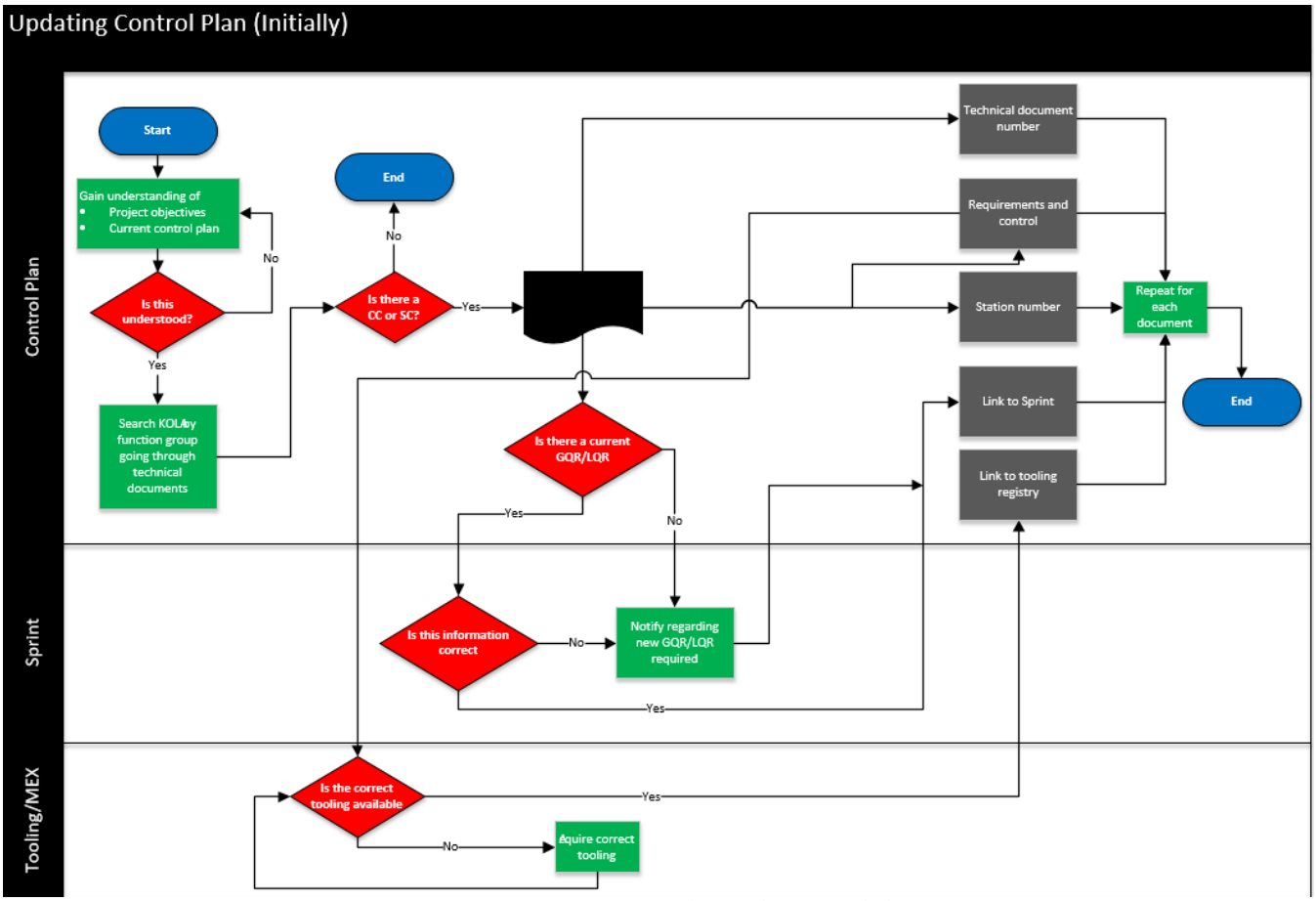


Figure 6: Project approach to update control plan

Note 1: *Sprint is a Volvo based software that provides a database for all quality requirements, assembly instructions and quality instructions for production*
Note 2: *MEX is a database for all tooling information including tool ID's, maintenance records and calibration results*
Note 3: *KOLA is a Volvo based software that provides a database for all items (parts, documents etc.)*
Note 4: *Other terminology includes: CC/SC = Critical/Significant Characteristic and GQR/LQR = Global/Local quality requirement*

4.2 Updated timeline

Throughout the course of the project, there has been some necessary changes made to the timeline due to meetings being reschedule halting progression onto different stages. The newly updated timeline with revised dates and added tasks due to the progression of the project.

1 Induction training	29/01/19	31/01/19
2 Feasibility Gate	1/02/19	1/02/19
3 Feasibility study	**4/02/19**	**21/03/19**
3.1 Stakeholder Interviews	4/02/19	25/02/19
3.2 Online Reflective Journal 1 (UQ)	8/02/19	8/02/19
3.3 Phase Deliverables: A1, A2, A3, B1 and B2	4/02/19	21/03/19
4 Project Proposal (UQ)	7/03/19	7/03/19
5 Online Reflective Journal 2 (UQ)	8/03/19	8/03/19
6 Development Gate	22/03/19	22/03/19
7 Development	**22/03/19**	**24/04/19**
7.1 Investment analysis	22/03/19	24/04/19
7.2 Approved plan in-depth analysis	22/03/19	11/04/19
7.3 Approved plan development	12/04/19	24/04/19
7.4 Online Reflective Journal 3 (UQ)	8/04/19	8/04/19
8 Investment Request Gate	3/05/19	3/05/19
9 Interim Report (UQ)	2/05/19	2/05/19
10 Final Development	**3/05/19**	**4/06/19**
10.1 Final development	6/05/19	4/06/19
10.2 Online Reflective Journal 4 (UQ)	8/05/19	8/05/19
11 Industrialization Gate	4/06/19	4/06/19
12 Industrilization	**5/06/19**	**24/06/19**
12.1 Online Reflective Journal 5 (UQ)	8/06/19	8/06/19
12.2 Industrilization	5/06/19	24/06/19
13 Oral Presentation (UQ)	13/06/19	13/06/19
14 Trimming in Gate	24/06/19	24/06/19
15 Trimming in	**25/06/19**	**28/06/19**
15.1 Trimming in	25/06/19	28/06/19
16 Final Report (UQ)	27/06/19	27/06/19
17 End Gate	28/06/19	28/06/19
18 Follow up	**1/07/19**	**20/12/19**
19 Updating Control Plan	**4/02/19**	**5/06/19**
19.1 CC and SC control points	4/02/19	8/05/19
19.2 Chassis Line	9/05/19	15/05/19
19.3 Volvo Line	16/05/19	22/05/19
19.4 Mack Line	23/05/19	29/05/19
19.5 OffLine/Other	30/05/19	5/06/19

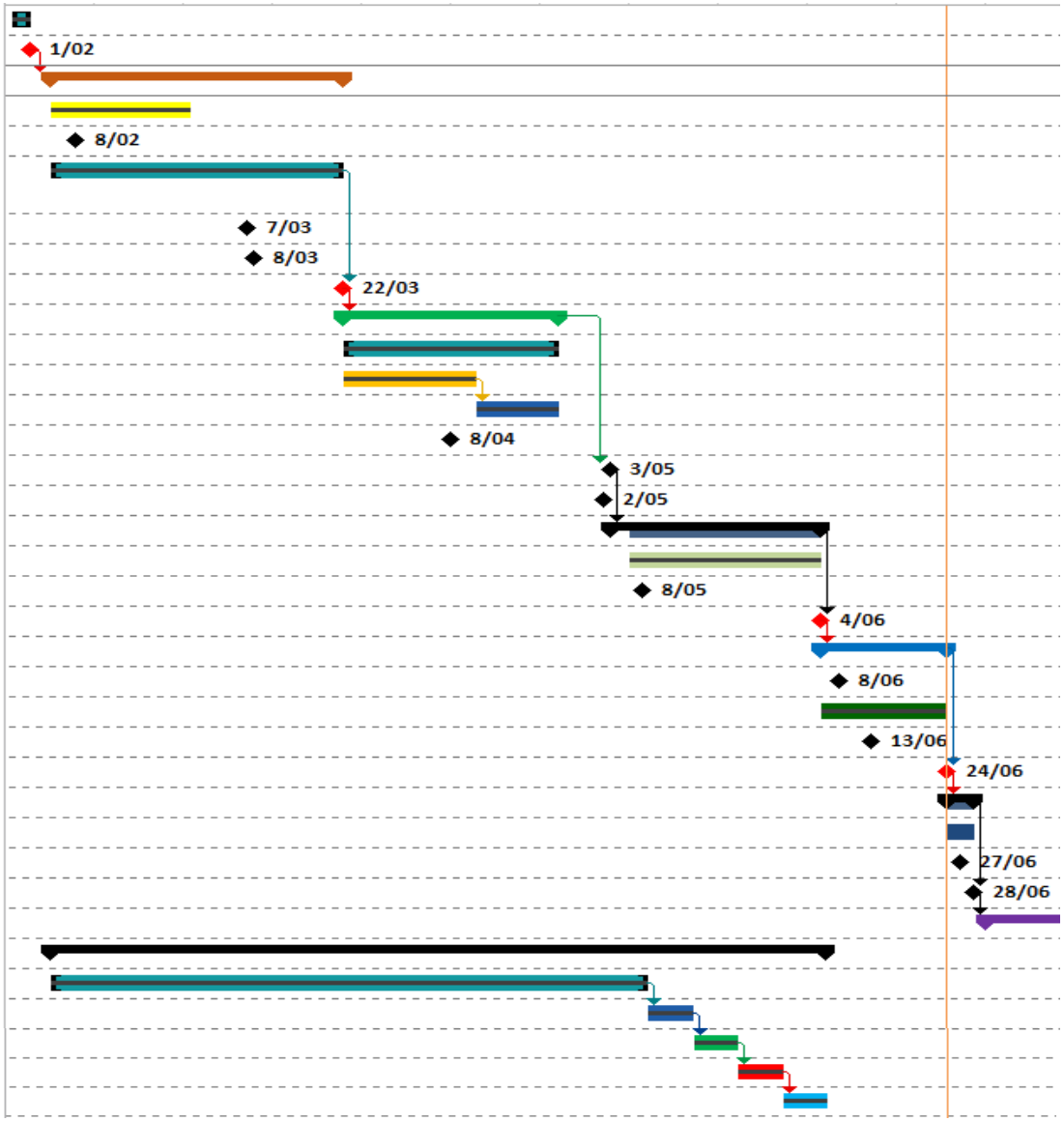


Figure 7: Final Gantt chart

5.0 Progress Results

Following the guidelines of the project management system whilst linking the principles of TQM and CM previously mentioned in section 2.1 and 2.3, the project has developed to a stage where implementation is possible. This includes the major three deliverables of the up-to-date control plan, the delivery plan and presentation of the new control plan.

5.1 Critical summary of project findings

With the project heavily focused around implementation strategies in the form of TQM and CM, the findings made to date consist of progress being made to successfully apply the principles of TQM and CM to the strategy for the implementation of the project. Concurrently, the formation of the control plan of which the implementation strategy will be enforcing continues to develop with the resultant progress being reported on in section 5.1.1.

5.1.1 Progress of the control plan

Using the literature review presented in section 2.2 alongside existing templates for control plans within the company, a template was formed. This template includes all the necessary aspects of a control plan based off ISO 9000:2015 and will be used as a foundation for the project. For ease of use, the template is broken down into four main sections with multiple sub sections.

Table 7: Control Plan Template Breakdown

Main Section	Sub Section	Information included
General Where requirements come from?	Reference Number	Linking number to requirement document in KOLA
	Date Reference Number	Date taken from KOLA DCN (Design Change Notice) format regarding new additions to requirements
	Reference Changes	Brief description of change occurring/occurred to the reference document
	Date CP Updated	Truck week of when changes to the control plan is made
	Changes Made	Brief description of change made
Corresponding Sprint Where requirements go?	Sprint (QR) Number	Linking number to Sprint GQR/LQR to simplify process of linking control plan to Sprint
	Issue Number	
	Row Number	
	Date Sprint Updated	Traceability reference to ensure changes made in the control plan are transferred into Sprint

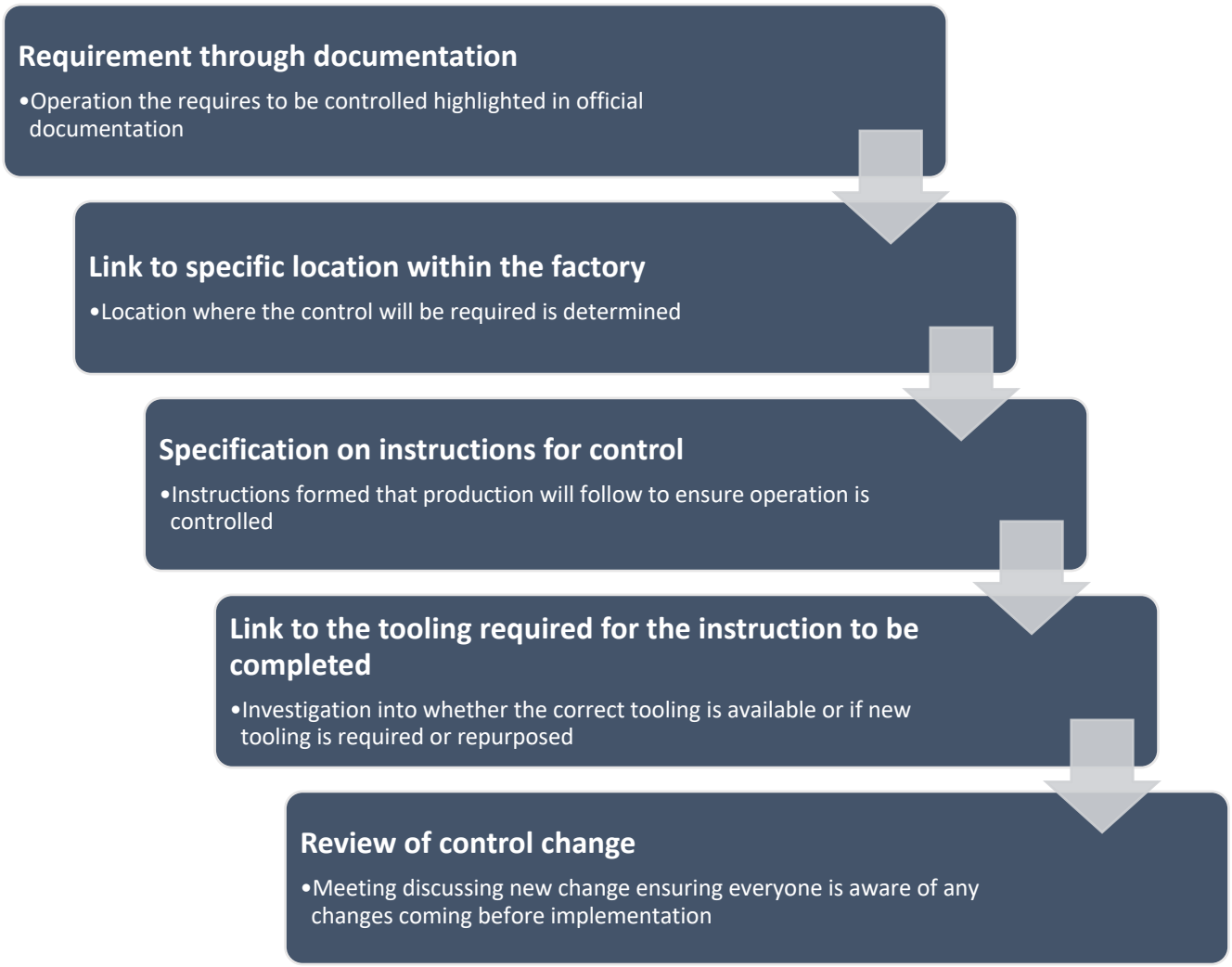
	Changes Made	Brief description of change
Operation What are the requirements?	Station Number	Location of where the operation will take place
	Applicable Variant	Variant to which the particular requirement applies
	Overview	More specific information regarding what the requirement is and instructions of the operations being performed (torque, length, pressure, check etc.)
	Requirement	Specific information needed to suit the operation
Tool What fulfils the requirements?	Type	Type of tool to be used for both assembler and quality inspector along with the specification (dial wrench, pneumatic tool, electric tool etc.)
	CpK/CmK	Outline of the capability process/machinability index for the tool used by the quality inspector or assembler to determine necessity of checks
	Link	Referenced link to the tool/calibration registry that contains all necessary information regarding tooling and maintenance

The decisions surrounding this template were made not only on research into control plans and analysis of previous editions, but also through consultation with quality technicians and the maintenance department. Throughout these consultations, current issues were addressed surrounding existing processes and suggestions for improvement. The minutes for these meetings can be found in Appendix F. With the template finalised, the process previously stated in figure 6 was followed to begin the filling out of all necessary control points. Currently, due to the large number of variations that are possible throughout the factory, there are 1324 control points. As this number of very large, it is vital that the control plan is well formatted and include all necessary filtering options to ensure the document is able to be used effectively.

It is critical that the main users of the control plan (quality technicians, production and maintenance) have an input into the useability and accessibility of the control plan and the information contained within. This allows for a simple implementation when this control plan is introduced into the factory. Thus, the control plan forms a cross-functional document linking information from numerous departments in a centralised system. This will form the first aspect of the TQM principles of strategic and quality planning along with the use of information and analysis. Ensuring this document is kept up-to-date with any changes in the factory or product is paramount and is the core reasoning behind an implementation strategy using the principles of CM, primarily focussing on the traceability of change.

5.1.2 Regarding principles of CM and TQM

With constant changes occurring in the process of design and production throughout the Wacol facility, a system is required to provide some structure to any changes. Through the use of Visio, an IDEFo diagram has been created outlining the baselines, activities and people incorporated in the process of updating the control plan. This is the major document forming the delivery plan for the implementation aspect of the project. The implementation strategy follows the process outlined below:



Through the following of this process, the IDEFo diagrams have been created for an in-depth implementation process to follow. In the following pages, the process designed for the maintaining of the quality control plan can be seen. At each stage an input, mechanism and control is used to produce a required output. This provides an in-depth process that, when followed, will ensure the successful maintaining of the quality control plan.

Maintaining Strategy Overview:

The first page of the IDEFo process flow in Visio is that of a general overview into the process to be followed based on the requirements for the control plan. In figure 8 below, it can be seen that the overall flow starts with a DCN (design change notice) or analysis result (root cause analysis etc.) and ends with the output of new controls. In the formation of this overview, the principles surrounding configuration management have been included. Through the linking of figure 8 and the information in the table below, how configuration management has been incorporated into the process as a whole can be seen on a high level.

IDEFo Phase	CM Baseline	CM Activity	Wacol activity
A1	Requirement	Identification	New idea/change Quality/Assembly requirements
A2 – A4	Design Release	Control Status Accounting	Control Plan LQR/GQR Creation
A5 – A6	Product Configuration	Status Accounting Verification/Audit	Core instructions Control card

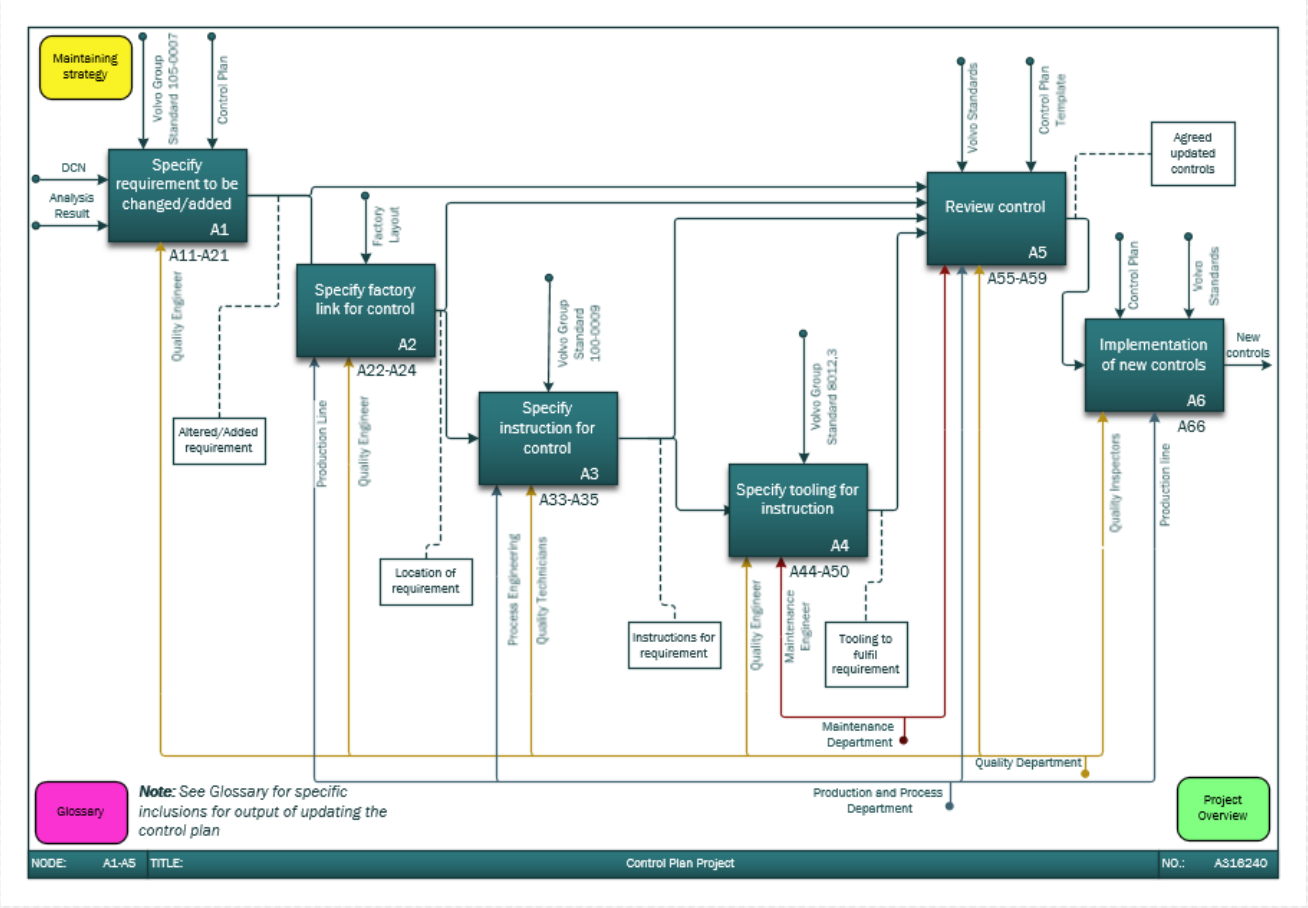


Figure 8: Overview of updating process (IDEFo format)

Input Factor 1 – Design Note Changes:

In figure 9, a further breakdown of section A1 from the IDEFo diagram is displayed. This breakdown elaborates on the input DCNs have on the control plan and how these will be managed. As the diagram shows, when a DCN is introduced, the information is reviewed and set for an introduction date into the factory. In order to ensure the control is in place at the appropriate time, communication is required between the quality engineer and the project team in charge of these DCNs. This will allow for the changes made to the control plan to be as per the requirements decided upon within the DCN.

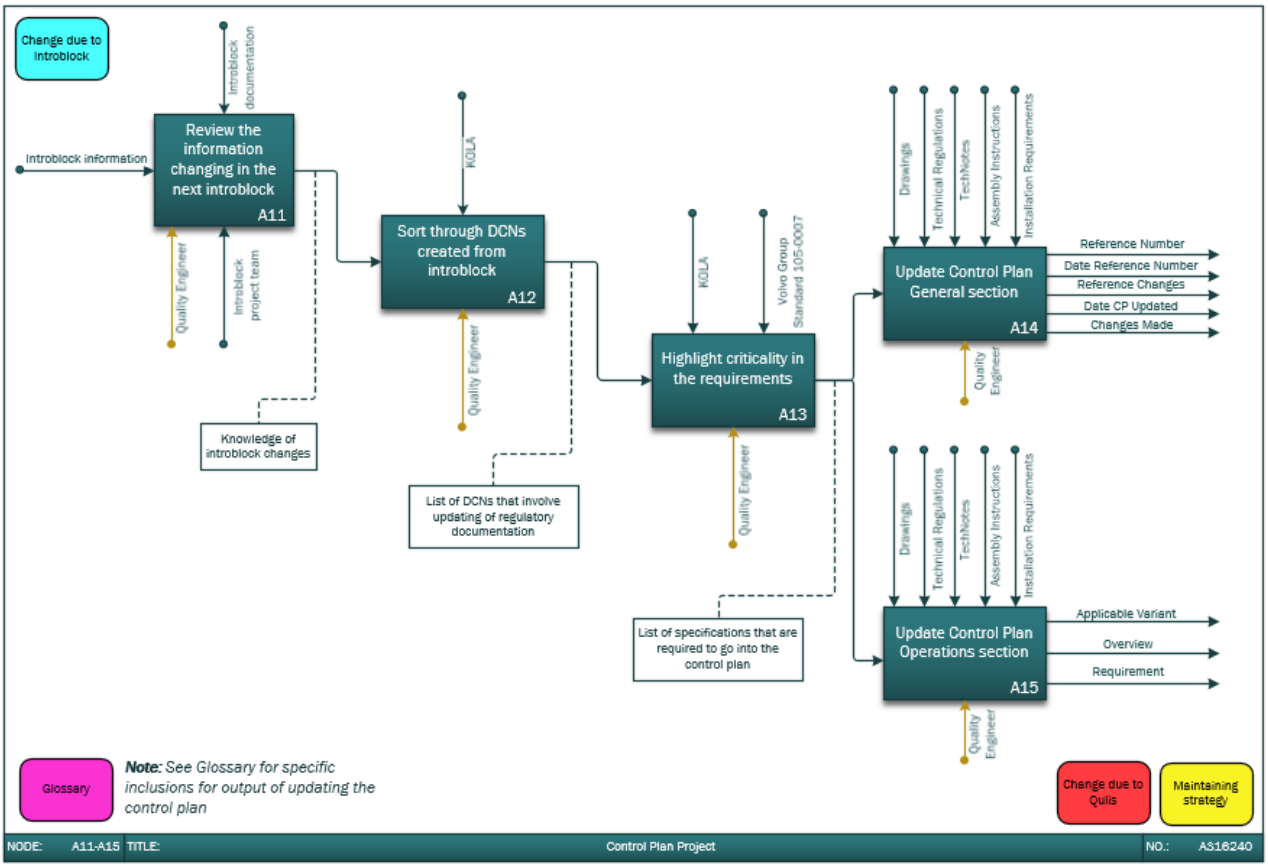


Figure 9: Change due to DCNs (IDEFo format)

This page of the IDEFo process helps to trace where the initial information for the control plan is taken from, forming the basis of the configuration management activity, identification and the baseline, requirements. With this process completed, the first system within Volvo can be successfully linked and the control plan updated accordingly.

Input Factor 2 – Analysis results:

This same process is repeated for the changes due to analysis results however includes an extra step for the traceability of when the control is valid.

Link to factory controls:

Following the initial link of the document database system within Volvo, the next step of the designed process is to ensure the location of the operation is accurate for the control being implemented. This is achieved through following the next page of the IDEFo process as shown in figure 10.

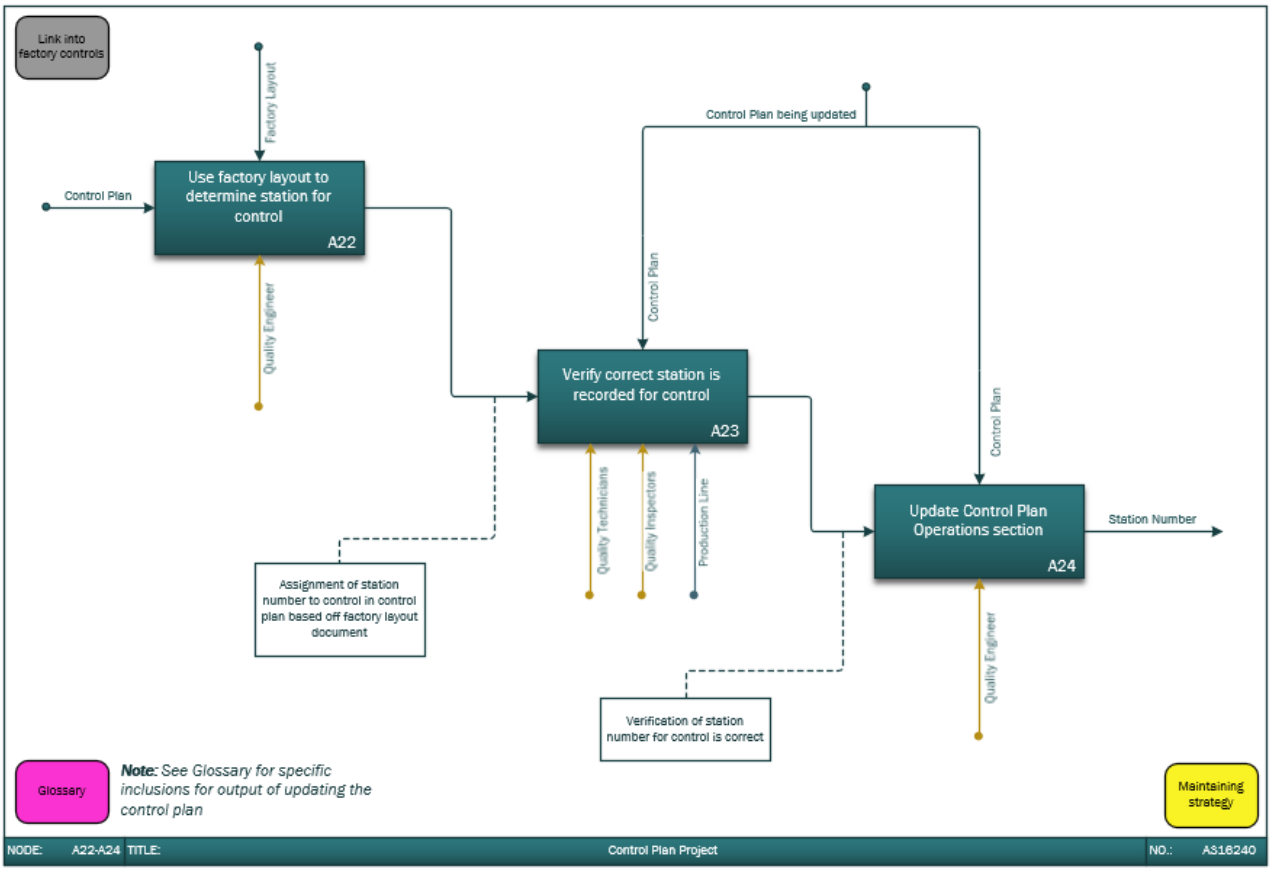


Figure 10: Link to factory controls (IDEFo format)

This aspect of the process requires multiple checking methods as to the correct location for the control. It is vital that this location is correct in order for the control to be managed correctly. When correctly linked, the control will be assigned to a station where the operation is taking place. This will allow for the next step of making/modifying the instructions to ensure the control is implemented throughout the production process. Being part of the control plan, this ensures the principles behind TQM and CM are followed with regards to the traceability of controls.

Link to instructions (Sprint):

Sprint is a system currently used within Volvo that extends upon the document database to create instructions for production and quality checks on the line. The linking of this system is the other major database that makes up the necessary information displayed within the control plan. With regards to the process of linking Sprint to the control plan, this could be in the form of the creation of a new

requirement or the updating of a current requirement. In figure 11 below, the designed process in the determining of this can be seen. This starts with a check into the pre-existing instructions before determining what is required to be done before updating the control plan based on the instruction number in Sprint. Ensuring this is maintained provides another section of the design release baseline in the CM principles.

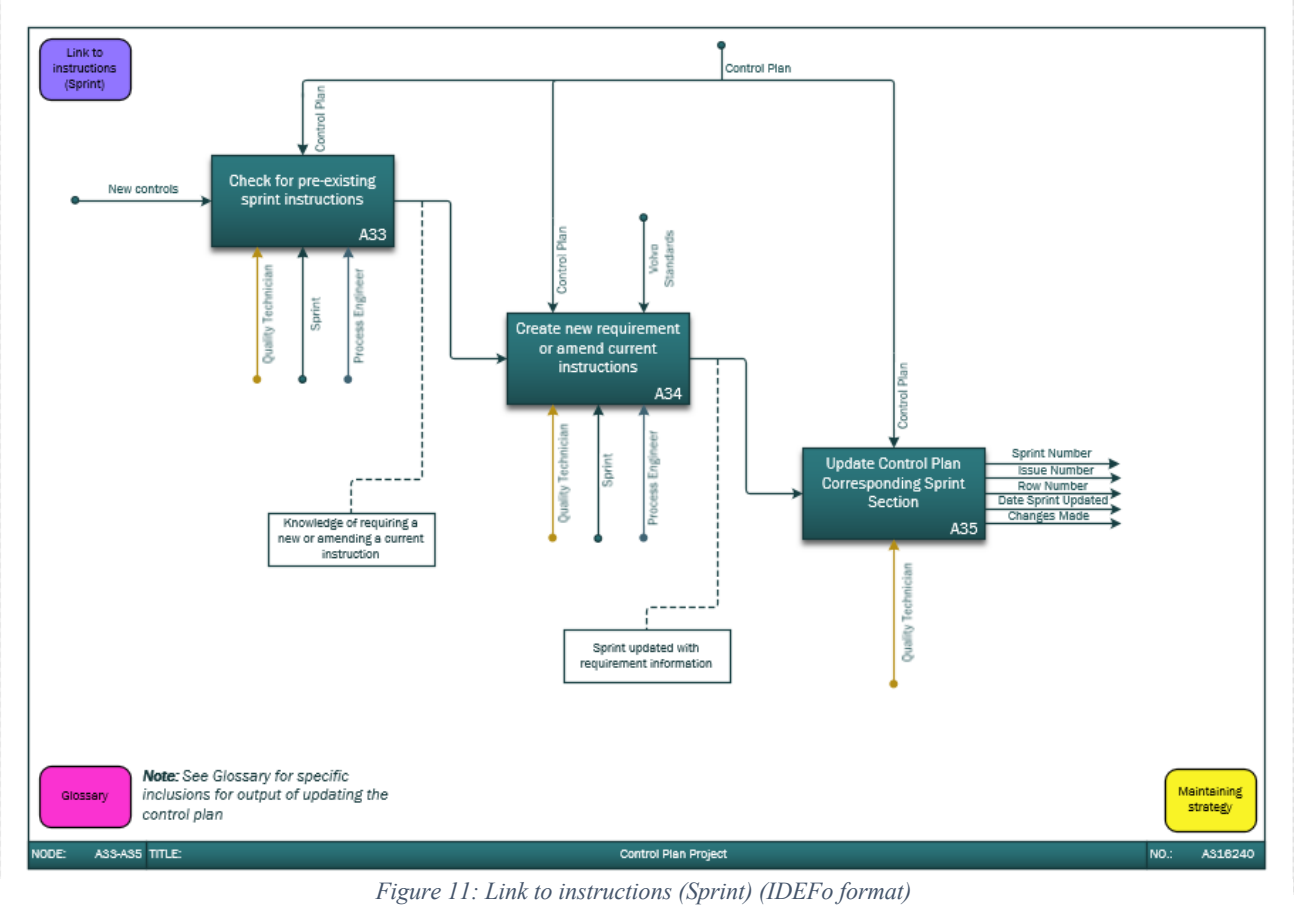


Figure 11: Link to instructions (Sprint) (IDEFo format)

Link to tooling:

The link to tooling provides the final system reference within the control plan. This link ensures the appropriate tooling is available and being used to control the operation. The inclusion of both tooling for production and quality allows for the traceability of tooling throughout the factory. Although this doesn't specify the exact tool that is used but rather the type and classification, the inclusion of a link to reference the tooling registry incorporates all necessary information about the tool that is being used. This results in a more general reference in the control plan but doesn't disregard the other information about the tooling that is necessary. The main reason behind this decision is based on the knowledge of processes in the factory and how tooling can be switched around if required to be repaired or calibrated by maintenance. The other tooling system includes all of this required information and although duplication within the control plan is not necessary, it should still be

referenced to complete the necessary requirements for the control plan. This process can be seen in figure 12 below.

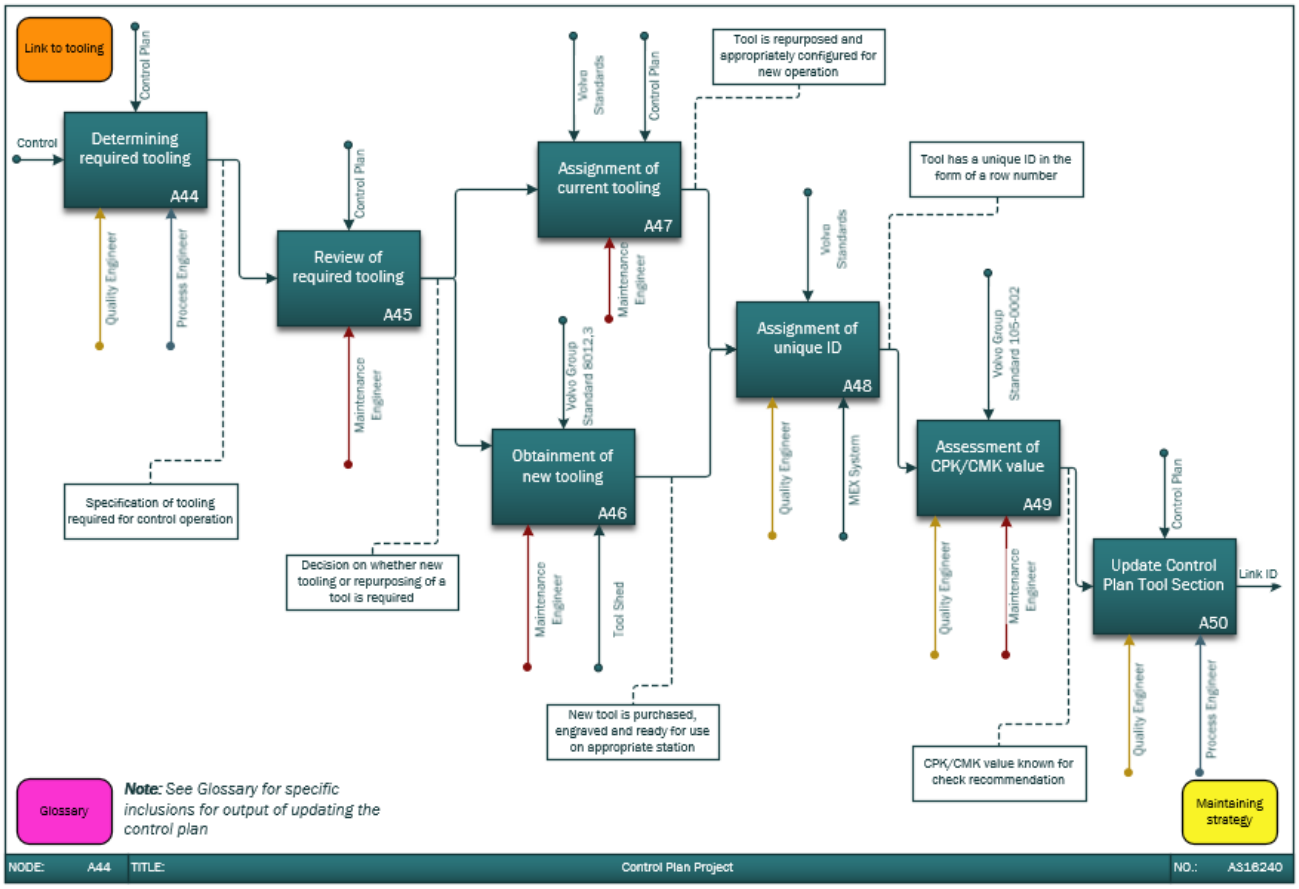


Figure 12: Link to tooling (IDEFo format)

Review of changes to control plan:

The next page of the IDEFo process flow begins the product configuration baseline in configuration management. In this stage, the changes made to the control plan are reviewed, verified and agreed upon by all involved. This ensures the changes made are smoothly transferred from the document and systems in place to the production line. Minor changes such as document number changes do not require approval by all parties as this will not affect the production but is more important from a reference point of view. However changes made to any values within the document or different variants will have major affects to the production line and as such it is important to be aware of these changes before they come into effect. This is achieved through multiple meetings where such changes are discussed as can be seen in the process flow in figure 13.

In terms of the configuration management activities, this forms the start of status accounting where changes made to the control plan and transferred into production. As these controls begin to be introduced, it is important that they are reviewed and verified completing the process flow in the final page of the IDEFo process flow.

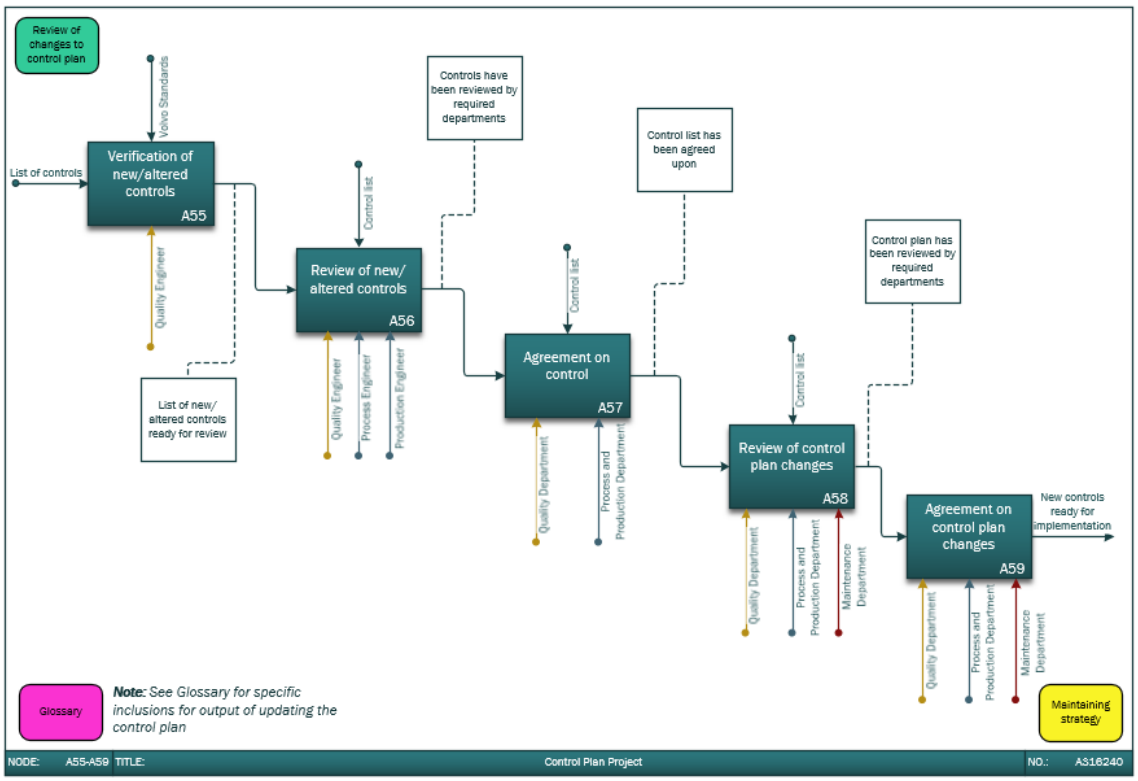


Figure 13: Review of changes to control plan (IDEFo format)

Implementing the controls:

With the new controls verified and ready for implementation, the new controls now require a process to be followed to ensure the TQM system is successfully followed and continuous improvement is able to be done. This can be achieved through the highlighted of controls on the station where the operation takes place and any issues that arise on the station being fed back through a printed version of the control plan to determine if new documents need to be created to amend the controls on a specific operation. The process can be seen in figure 14 on the following page. This can then be reviewed and highlighted to the engineers working on the technical documents to investigate and possibly improve the process.

This fulfils the final baseline and activity within the configuration management system through the verification and auditing of the new controls. In following this process, configuration management would be able to be successfully implemented throughout the factory.

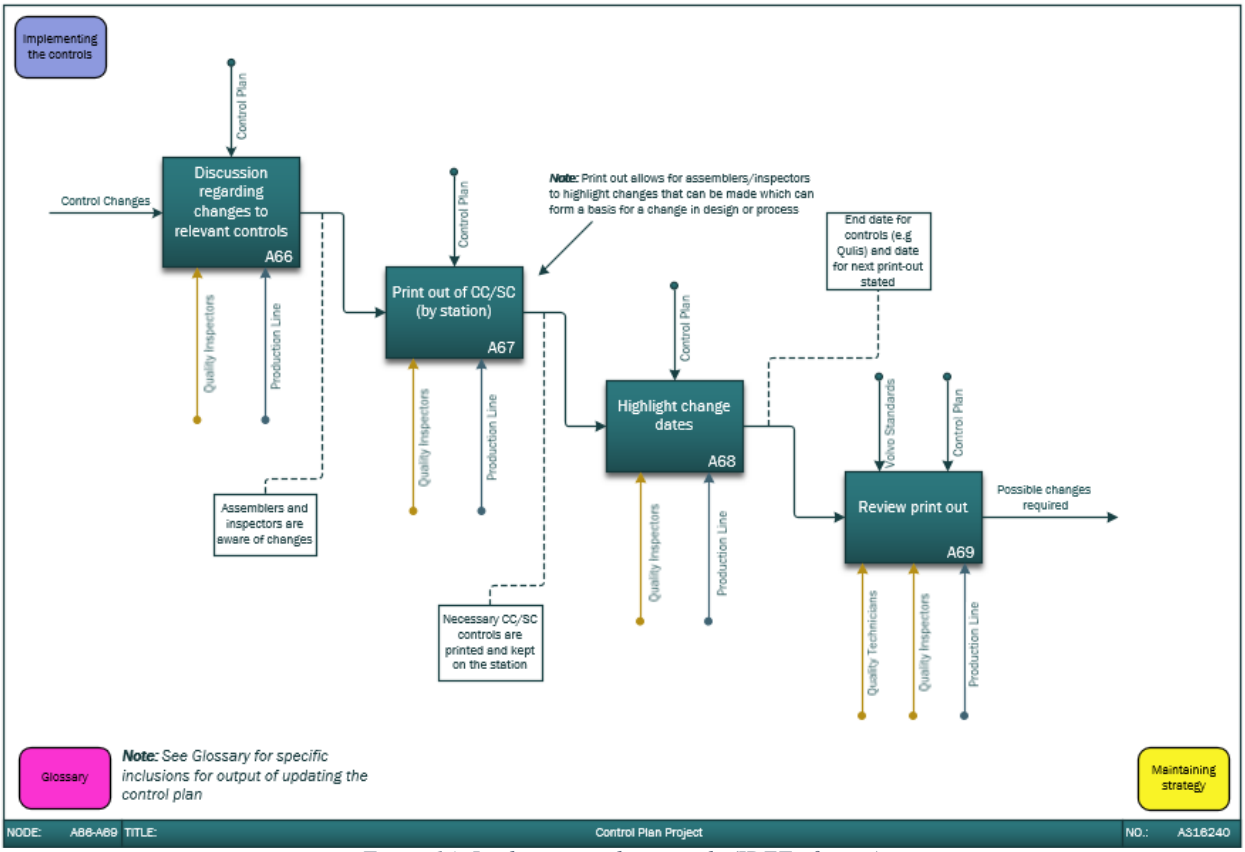


Figure 14: Implementing the controls (IDEFo format)

A complete view of this IDEFo process flow can be seen in Appendix E.

Alongside the formation of this process and the updating of the control plan, multiple meetings have been held with department leaders to ensure that communication is maintained and any issues are brought up throughout the project. This is useful to guarantee that the other main principles of TQM, leadership and management of people, are developed as the project progresses.

5.1.3 Key Issues that were faced

Throughout the progression of the project, there were many issues that were faced that had an impact on the outcome. These ranged from issues in relation to communication breakdown to technical set-backs. In the tackling of these issues, the project was able to be developed based on the solutions found throughout the progression of the project.

One key issue that has been a cause for concern is the communication breakdown due to Volvo being a large global company with multiple systems being managed by different countries. The main issue that arises from this is an unstandardized way of working for different systems. This can cause problems

when it comes to trying to link multiple systems through the control plan. Through confronting this issue, meetings were held with international members to become involved in the process of formulating the process and information contained within the control plan. This ensured that the necessary people knew of the existence of the project and what was currently being done to issue the project was a success. Not only did this help to manage the issue of miscommunication, it also helped through the gaining of additional feedback and support from members throughout different fields and locations of the company.

Another issue that was faced throughout this project was that of the inclusion of automation of the process. Initially, it was thought that the whole process could be automated from change in control to implementation of control. However, due to the complexity of software that is currently used at the factory, this is not possible without a complete overhaul of systems. As this is outside of the scope of the project, this cannot be done. Thus, the idea of automating the whole process had be revised to the automation of process information in regards to responsibilities. This would include the creating, assigning and tracking of tasks throughout the process of updating the control plan. Initially it was found that this could be done using software such as Trello, however there is limited automation capabilities. After meeting with the IT department, research was conducted into the integration of Microsoft Planner and Microsoft Flow. These systems are able to be set up to follow the designed IDEFo process that will be used to maintain the control plan. In Microsoft Planner, sections can be set up as to the operation requiring to be completed and tasks can be created and assigned within this section. An example of this can be seen in figure 15 below.

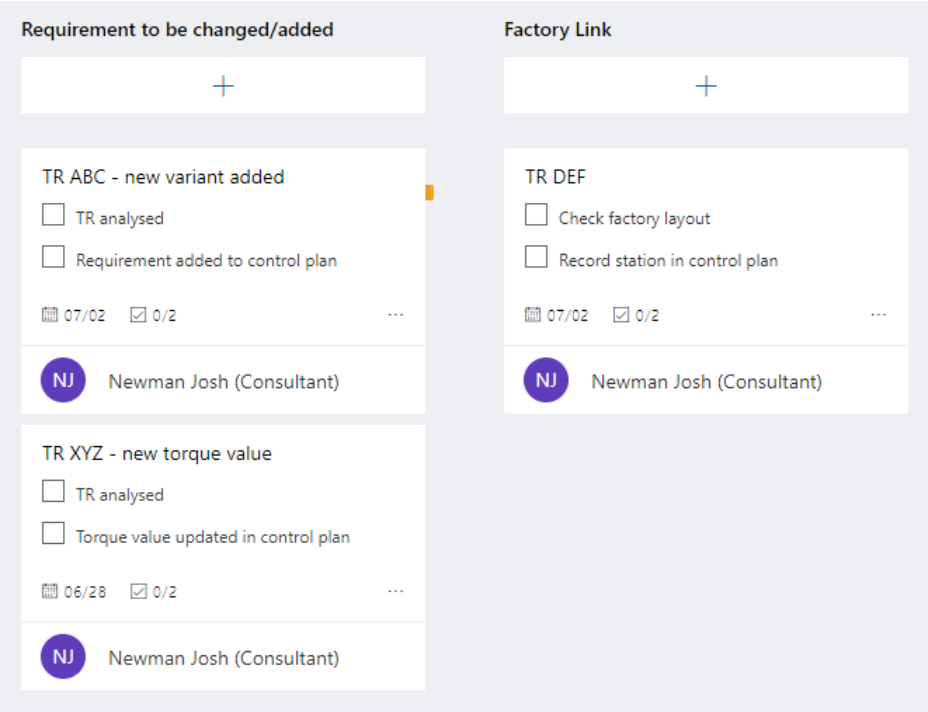


Figure 15: Example of Microsoft Planner usage

In regards to Microsoft Flow, there is currently a limited amount of capabilities due to the software being rather new as part of the Microsoft 365 package. As such, a basic automation can be set up however further investigation is required into how best to utilise this software for the control plan. It is recommended that this should be used in conjunction with the IDEFo process flow and Microsoft Planner in the future.

6.0 Conclusions and recommendations

The quality control plan project has been able to deliver the groundwork required to continue developing a quality control plan through the application of the defined IDEFo process flow. Through analysis of previous editions of the control plan and a literature review into the necessary components, a template has been formed that incorporates all required information and abides by the according standards. In the formation of the contents for the quality control plan itself, the implementation strategy was able to be adapted based on issues that arose to form a final implementation strategy. Based on this strategy, software is being trialled with regards to automation of the process. Although limitations have been found regarding automation, further research is being done to finalise a form of automation that would benefit the process. With full cooperation throughout the factory and integration with the management systems of total quality management (TQM) and configuration management (CM), the implementation of this project will be possible. However, before implementation is able to commence, the control plan does need some aspects finalised and completed.

It is recommended that this control plan should be used as a global template for Volvo factories with the Wacol factory being a pilot for the implementation of a process to maintain the control plan. Once all the necessary inputs are completed, the document should be introduced factory wide. With the current control plan including all the necessary critical and significant controls, it is also recommended that additional controls should be added where seen fit. The quality control plan should be a live document with the possibility to be every changing whilst retaining the necessary level of traceability in control and through the following of this template and this process, this can be achieved.

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8.0 Appendices

8.1 Appendix A – Risk Management

8.1.1 Updated risk management

As the project has progressed, more risks were found and as such, the risk management system has been updated. With the project remaining a mainly software based project, the majority of the risks associated throughout this placement consists of software related issues. However, due to the location and operations that are undertaken at the factory where the project is taken place, there are still some physical risks that need to be considered. Moving closer to implementation, the risks associated with the location and operations have become more likely. The following risk levels where decided based on the risk matrix in appendix B.

8.1.2 Safety risks

Safety risks include risks that may be harmful to the person responsible or to people within the vicinity. The main safety risk associated with this project is with regards to prolonged screen time causing issues with eye sight. There is also risks involved with interactions on the production line however due to the limited time spent on the production line, these risks aren't as severe.

Table 8: Safety risk analysis

Risk Description	Risk Value	Preventive actions to be taken	Consequence actions to be taken	What was updated and why
Improper training → Harmful actions in production	16	Necessary training is undertaken where required Correct PPE is worn at all times where required	Timing of looking at production line taken into account to ensure limited intrusion Processes involved in production are understood	Risk value increased from 8 → 16 Increased severity due to location of new work being carried out
Prolonged exposure to screens → Eye strain	16	Breaks taken throughout the day to give eyes a rest from computer screens	Ensure computer screens are set up correctly with limited glare and need for eye strain	N/A

8.1.3 Project related risks

The other important aspects of the risk analysis that must be understood is any delays that may incur due to issues extending from the workplace or personal matters. The main project related risks associated with this project is with regards to long periods of illness and hardware failure. As the size of the project team is minimal, prolonged illness could result in major delays in the project. In addition to this, there are numerous moderate and low risk events involving possible implications in the workplace. These can be seen in the following table.

Table 9: Project related risk analysis

Risk Description	Risk Value	Preventive actions to be taken	Consequence actions to be taken	What was updated and why
Hardware failure → Lost progress	15	Hardware isn't overloaded with unnecessary information	Copies stored on network as back-up regularly	N/A
Network failure → Lost progress	5	System is regularly updated	Copies stored on local drive as back-up regularly	N/A
Long period of illness → Delay in project	15	Fast action and precaution is taken to reduce length of time spent away from the project Flu needle should be taken to reduce chances of severe flus	Ensure project has set milestones which are kept allowing for possible illness	Risk value increase 12 → 15 Increased due to the time of year Preventative action added
Not approved investment → Project stand-still	1	Continuously update the project, keeping relevant people informed to ensure all information is known and there is constant feedback	Ensure multiple solutions are researched with varying levels of investment required so if one solution is too much there is another to use instead	Risk value decreased 5 → 1 Decreased due to investment no longer required

Process extends production time → Implementation not viable factory wide	6	Testing completed throughout implementation process as to ensure any additions to production process doesn't hinder progress	Sections of the production line are tested individually before a full implementation	N/A

8.1.4 Commercial and community risks

In addition to OH & S and project related risk, there are also risks that could arise due to commercial and community issues. This could be in the form of limitations placed due to industry standards or complications enforced by the workforce community. In regards to this project, the main issues in this aspects are arguments opposing the implementation of new processes as seen in the table below.

Table 10: Commercial and community associated risk analysis

Risk Description	Risk Value	Preventive actions to be taken	Consequence actions to be taken	What was updated and why
Personnel changes → Communication issues	10	Work with multiple people within different departments	Ensure documentation is kept up-to-date with minutes recorded from any meetings ensuring any new member can quickly get up to speed	Risk value increase 8 → 10 Increased likelihood due to changes already being seen in the workplace
Resistance against change → Implementation delays	9	Constant engagement with concerned parties addressing areas of disagreement throughout project	Feedback provided throughout project is acted upon and discussed with relevant parties	N/A

8.2 Appendix B – Reflection on key skills and lessons learned during placement

Throughout the duration of this placement, I have learnt about many aspects of a professional environment. In being part of a large company for the first time, I feel that my placement has been a crash course on workplace attitude, etiquette and ethics. From daily meetings with quality technicians and going on test drives with the audit department to hosting monthly meetings with department leaders I have been exposed to many new learning experiences. In the following pages, I have included just some of the key skills I have learnt and lessons that I have learnt from throughout my placement.

8.2.1 Working as part of a project team

EA Competencies

- EA 1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline
- EA 2.4 Application of systematic approaches to the conduct and management of engineering projects
- EA 3.6 Effective team membership and team leadership

As part of my project, I am required to work as part of a team consisting of different authority levels and also different expertise. In one of our first meetings, the expectations and required software to be used was established. However, still after 4 weeks I was waiting on access to some systems that I required for the project. This meant that I was unable to continue with certain aspects of the project. At the same time, this did encourage me to reach out to others involved in the project to further my knowledge while I wait. This helped me to continue to work on jobs that weren't directly related to my project but have the same processes I will use in the future. The first action I took was to look at other jobs relating to the project that I could being to work on. This encouraged me to seek out help on the understanding of current factory processes as well as conduct research into possible solutions to help with the project.

From this situation, I learnt the importance of cooperation and communication throughout a project. This includes the acknowledgement that I may not know the most about a particular aspect of the project and that it is best to ask for help rather than sit there and wait for something to be fixed. Knowing possible hurdles that I may face during the project helped me to conduct some specified research and sign-up for some training programs that will help with my understanding of a particular topic. As the project develops, I continue to become more involved with different projects within the company as this has helped me further develop my understanding of both how a project is run (helping

with my project management development) and the process within the factory. I believe this has and will continue to be the best way for me to make the most of my stay during my placement.

8.2.2 Hosting a project meeting

EA Competencies

- EA 1.1 Comprehensive, theory-based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline
- EA 2.2 Fluent application of engineering techniques, tools and resources
- EA 2.4 Application of systematic approaches to the conduct and management of engineering projects
- EA 3.6 Effective team membership and team leadership

Being the project leader throughout my time at the placement, I am required to host numerous meetings with concerned parties. These meetings are based around a tooling situation. I arranged a time and room whilst preparing a small presentation regarding the outline of the information I was hoping to discuss. With the meeting concerning people from different departments (maintenance, production engineering and quality), there were some disagreements on outcomes. With some heated discussion occurring throughout the meeting, I became quite unsure of what to do to regain control of the meeting. For a short period, this led to me taking a back seat at the meeting and the discussion veering off track. Although this wasn't helpful for the specific items addressed in the meeting, it did make me aware of other issues with the project that I may need to address at a later stage. As discussions continued, I began to input more into the conversation and link it back to the task at hand. This helped me with my confidence in a work environment as I was able to regain control over discussion and continue with the meeting. I also arranged a time with both parties to ensure that their concerns were addressed to make sure all were happy with the outcome of the meeting.

From this experience, I learnt the difference between a good educated discussion and an unwarranted argument. I also learnt how quickly a meeting can become side-tracked and how important it is to keep discussion flowing on the topic that needs to be addressed. I also learnt that although arguments can bring light to unseen issues, it is best that these occur in a more private meeting where issues can be addressed in full. I know I will have many more meetings throughout this placement, so I will learn from the first one and improve for the future. This will be achieved by creating a PowerPoint for the meeting where each topic is presented and structured. This will create less confusion on what the discussion is about and give everyone something to focus on throughout the meeting. With this

implemented, I believe meetings will go more smoothly and the outcome will be more beneficial to all parties.

8.2.3 Trialling of proposed method to keep up to date with factory changes

EA Competencies

- EA 1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline
- EA 2.1 Application of engineering methods to complex engineering problem solving
- EA 2.3 Application of systematic engineering synthesis and design processes
- EA 3.3 Creative, innovative and pro-active demeanour

One aspect of the project is to ensure any changes that are made that will influence the production in the factory is flagged and necessary information included within the control plan. In attempting to do so, I conducted a trial run of a method to ensure I am notified whenever these changes are made. This involved setting up a notification system in one of the Volvo specific software packages. With this system set up, I received notifications whenever a change was included in the software package. However, the trial having mixed outcomes. It did provide me with notifications whenever a change was made however these were then required to be sorted once again for both the necessary location and specifications. In addition, when the change was relevant it wasn't always valid at the time of creation but rather a "place holder" with no time/date of introduction.

Based on the outcomes of the trial I was unsure of how to distinguish the relevant changes. When bringing this up in my weekly meeting, I was informed that there was already someone responsible for providing time/dates to the introduction of changes. From this experience I learnt two things, firstly, the necessity of a trial run before implementation and secondly to communicate options with the team to ensure work is done efficiently with no one working on the same item. Based on this discussion in the meeting, I will be meeting with the person/people responsible and discussing what I am hoping to achieve by using this system and possible ways to implement it into the process.

8.3 Summary of learning experiences

In summary, throughout this placement I have learnt the necessity of asking for help and the importance of providing structure when it comes to meetings among other skills. My confidence has grown and my knowledge of both systems in place at the Wacol facility and general engineering practices has further developed. I have learnt valuable skills in communication through the completion of meetings throughout my placement and been able to develop my engineering skills through my work formulating the control plan.

8.4 Appendix C – Communication plan

Table 11: Communication plan

Information Activity	Responsible	Receiver	When	How	Remarks
Outlining of requirements and expectations of the project	Edney Ferreira Alessandro Ferreira	Joshua Newman	22/01/2019	Meeting	Meeting provided necessary information to start formulating documentation for project directive
Updating of current progress of project along with plan for following week	Joshua Newman	Edney Ferreira Alessandro Ferreira	25/01/2019 Repeats weekly	Meeting	Discuss progress made throughout the week and inform plan for following week
Gathering of expectations of the project and the influence it will have on stakeholders	Lee Morphew Patrik Woodrow Jody Beck Heather Sinclair Arnold Horne	Joshua Newman	01/02/19 - 08/02/19	Verbal/Email	Few questions regarding stakeholder analysis to gain understanding of expectations and influence
Determination of viability of solutions found throughout feasibility study	Joshua Newman	Process Engineering, Production Engineering and Quality	Four meetings throughout feasibility study	Meeting	Progress of solutions found communicated ensuring that further research can be completed through understanding of how this will be implemented
Confirming types of tooling and processes used throughout production line	Process technicians / Assemblers	Joshua Newman	1 hr session per week	Verbal	Updating of quality control plan requires the checking that processes written in control plan are done on production line
Clarification of current control plan	Arnold Horne	Joshua Newman	5/02/2019	Meeting	Understanding of information currently included in control plan required along with where this information can be found
Implementation strategy for the new control plan	Process Engineers Production Engineers	Process technician Joshua Newman	Fortnightly	Meeting	Determination of how the new quality control plan will be implemented across the factory
Finalising of new control plan method and strategy for implementation to be approved by required parties	Joshua Newman	Required parties to obtain approval	25/06/2019	Meeting	Approval required to be obtained in order to fully implement strategy into the production process - vital for a successful project

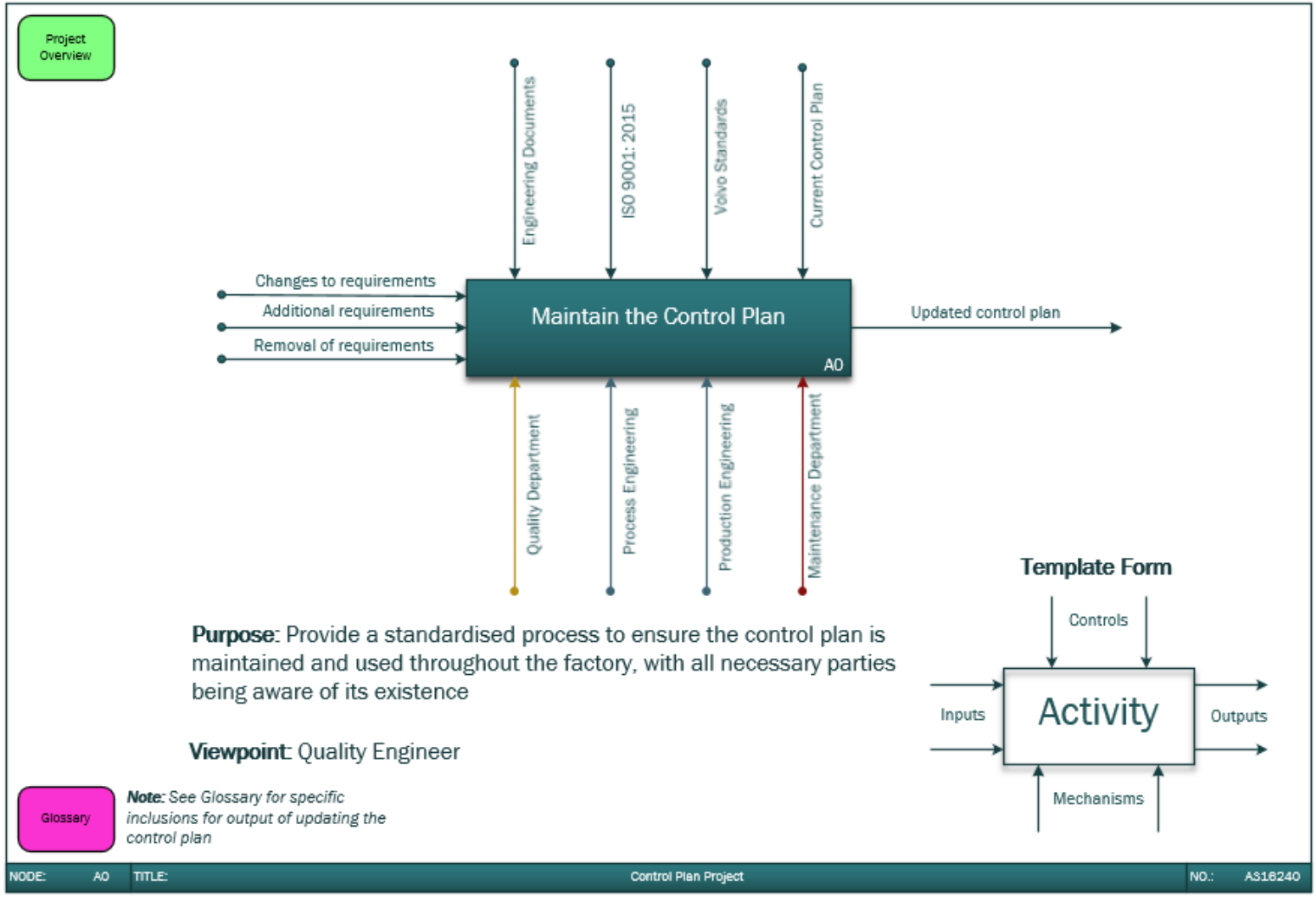
Updating of current progress along with issues that are being faced in production line	Joshua Newman Jody Beck Heather Sinclair Arnold Horne Alessandro Ferreira	Joshua Newman Jody Beck Heather Sinclair Arnold Horne Alessandro Ferreira	Everyday	Meeting	Meeting which provides feedback from stakeholders regarding possible solutions to implementation of new method along with issues that are currently occurring
Overview of project outlining information regarding method of quality control	Joshua Newman	Jim Andersson International manufacturing quality team	04/06/2019	Meeting	Sharing of current strategies/solutions found along with keeping stakeholders updated
Discussion regarding progress of project and direction it is headed in along with agreement of various project stages	Joshua Newman Edney Ferreira Alessandro Ferreira Patrik Woodrow Lee Morphew	Joshua Newman Edney Ferreira Alessandro Ferreira Patrik Woodrow Lee Morphew	Monthly + at each of the gates	Meeting	Required to ensure project is on track and approval to continue with solution/plan is granted
Information session to help with tooling information on the Volvo main line and initial meeting with production engineering (PE)	Joshua Newman Alexander Matta	Joshua Newman Alexander Matta	17/04/2019 + Fortnightly review	Meeting + Email	Initial meeting gave insight into how PE would use the control plan and provided a useful point of contact for tooling information

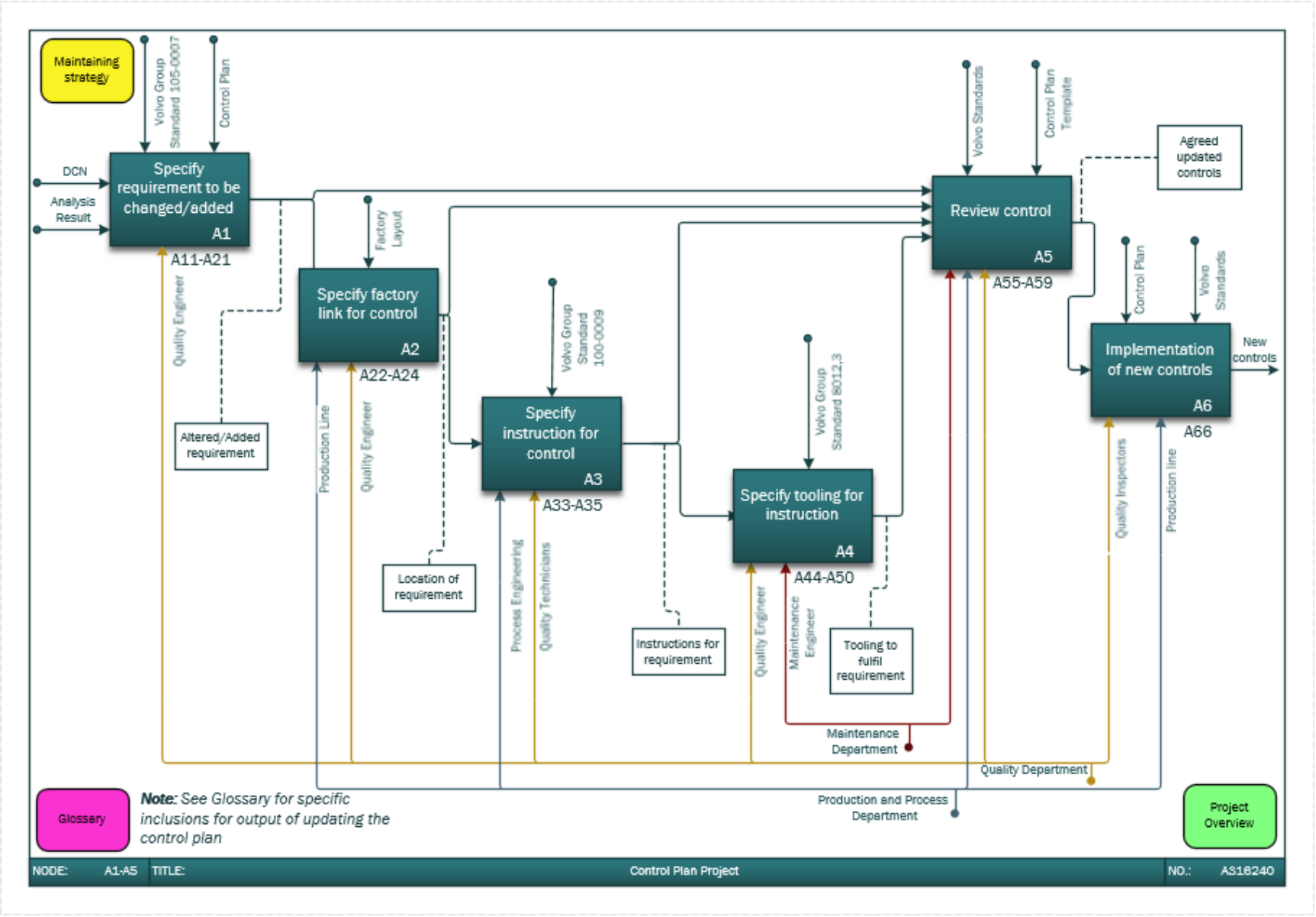
8.5 Appendix D – Risk Matrix

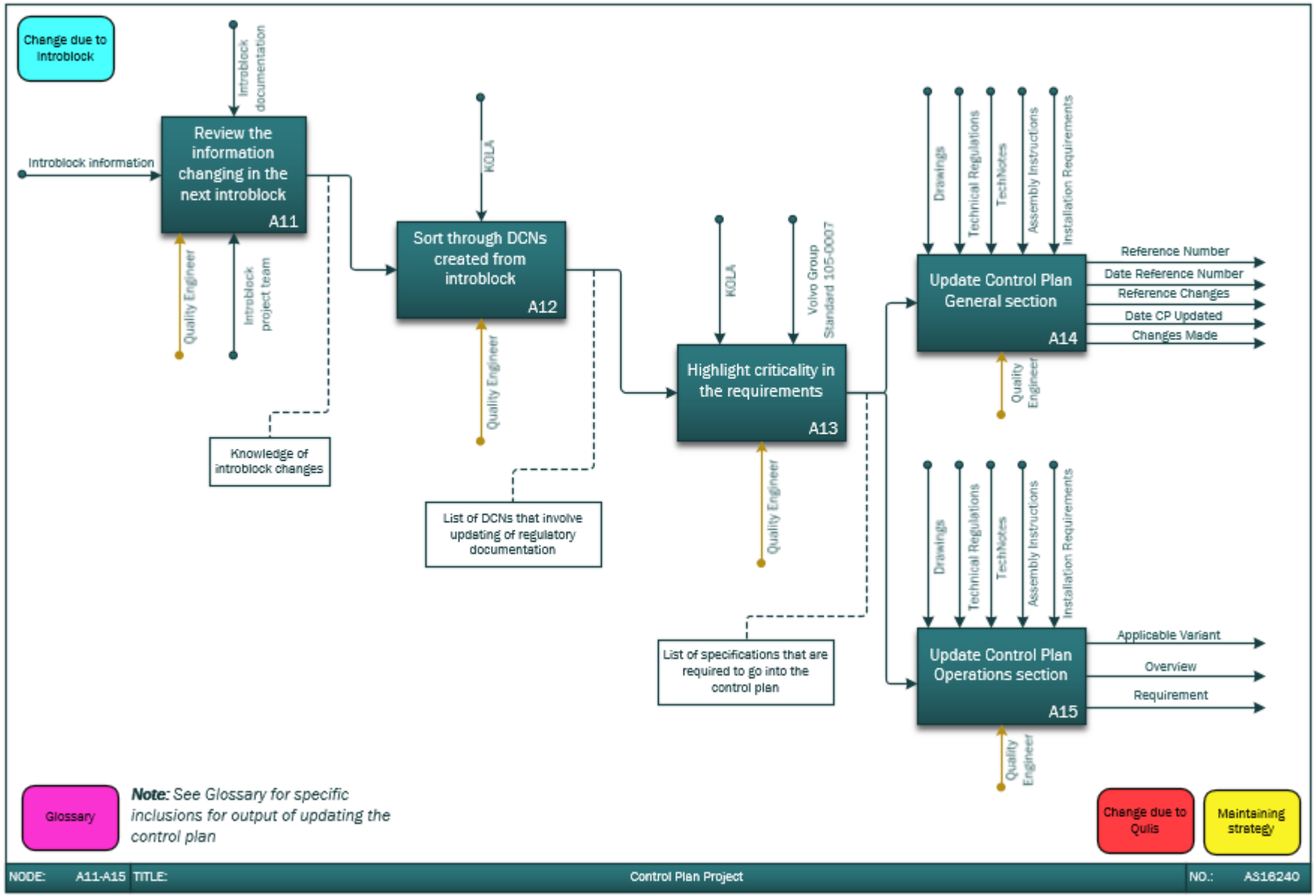
Table 12: Risk Matrix

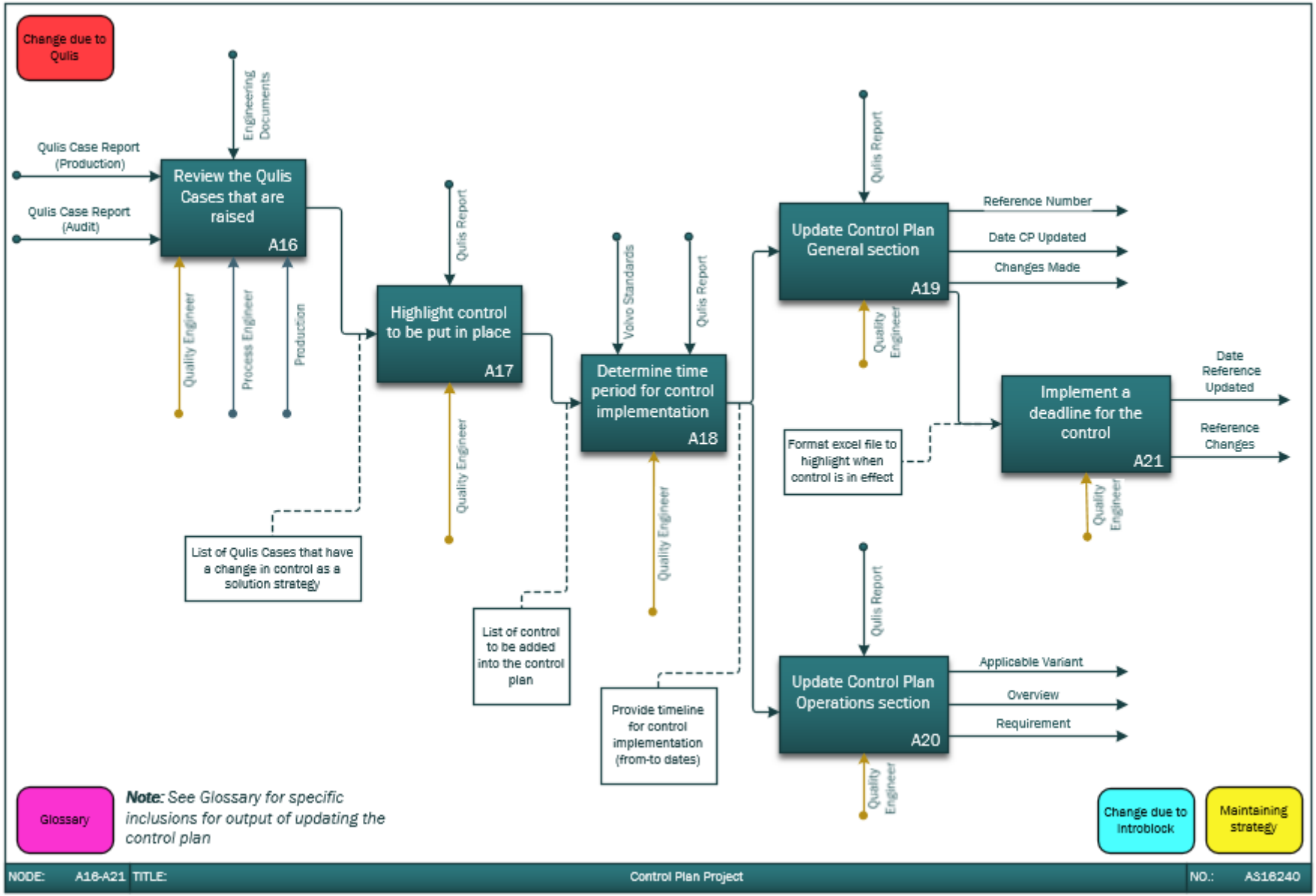
		Consequence				
		Negligible (1)	Minor (2)	Moderate (3)	Major (4)	Severe (5)
Definitions	OH & S	Discomfort felt or First Aid required	Medical treatment required	Hospitalisation	Lost Time Injury or permanent injury	Fatality/ies
	Project	No/Minor effect on time line	Delays needing limited extra work to recover	Delays requiring overtime to catch up on lost time	Delays requiring project scope to be reconsidered	Unable to complete
	Commercial and community	Local complaints	Local complaints and minor media attention	Local complaints and major media attention	Negative media publication	Severe media and public implications
Likelihood	Almost certain (5)	5	10	15	20	25
	Likely (4)	4	8	12	16	20
	Possible (3)	3	6	9	12	15
	Unlikely (2)	2	4	6	8	10
	Rare (1)	1	2	3	4	5
Risk Value						
Low Risk 1 - 6		**Moderate Risk** 7 - 13	**High Risk** 14 – 20		**Severe Risk** 21 - 25	

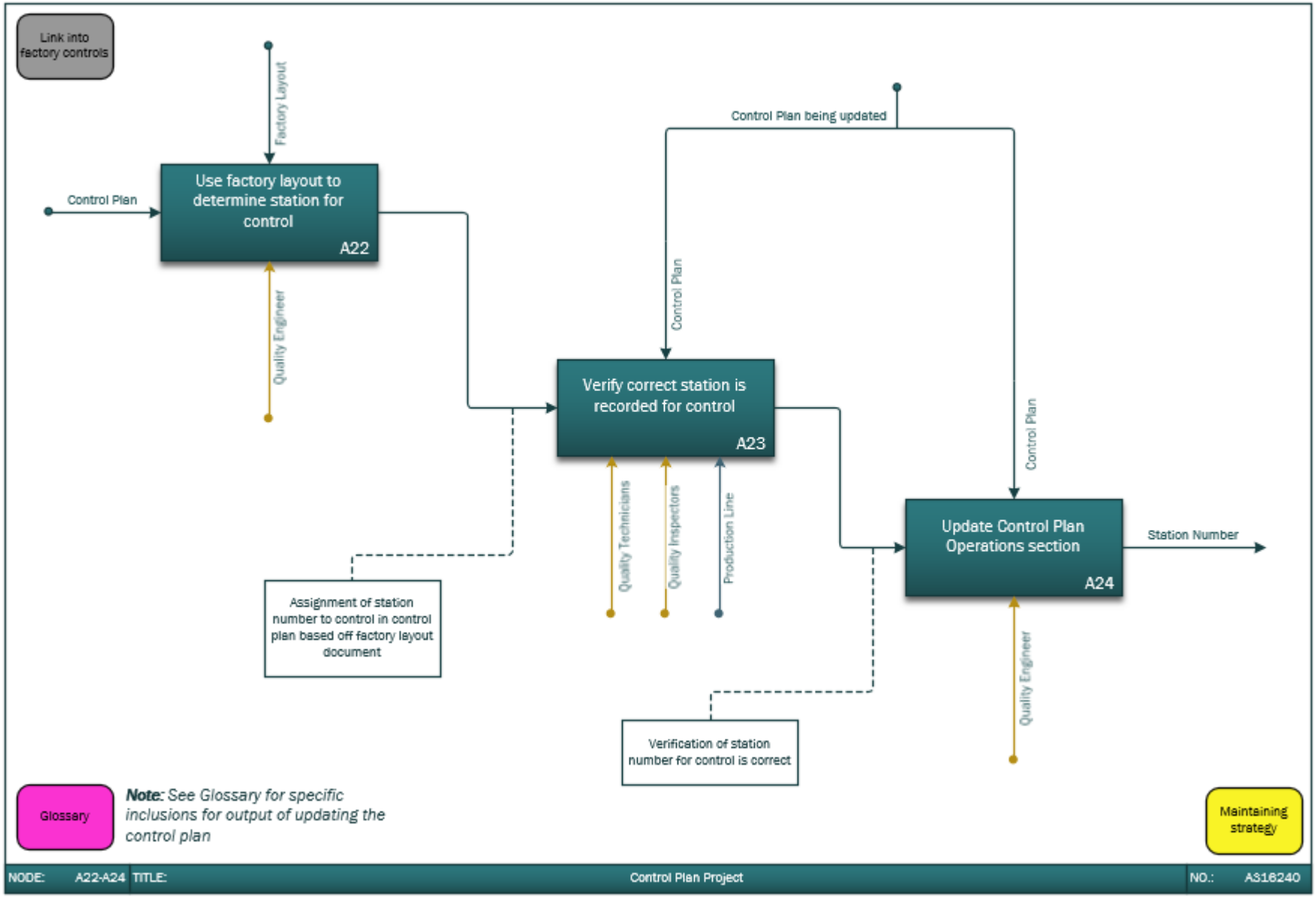
8.6 Appendix E: IDEFo Complete Process

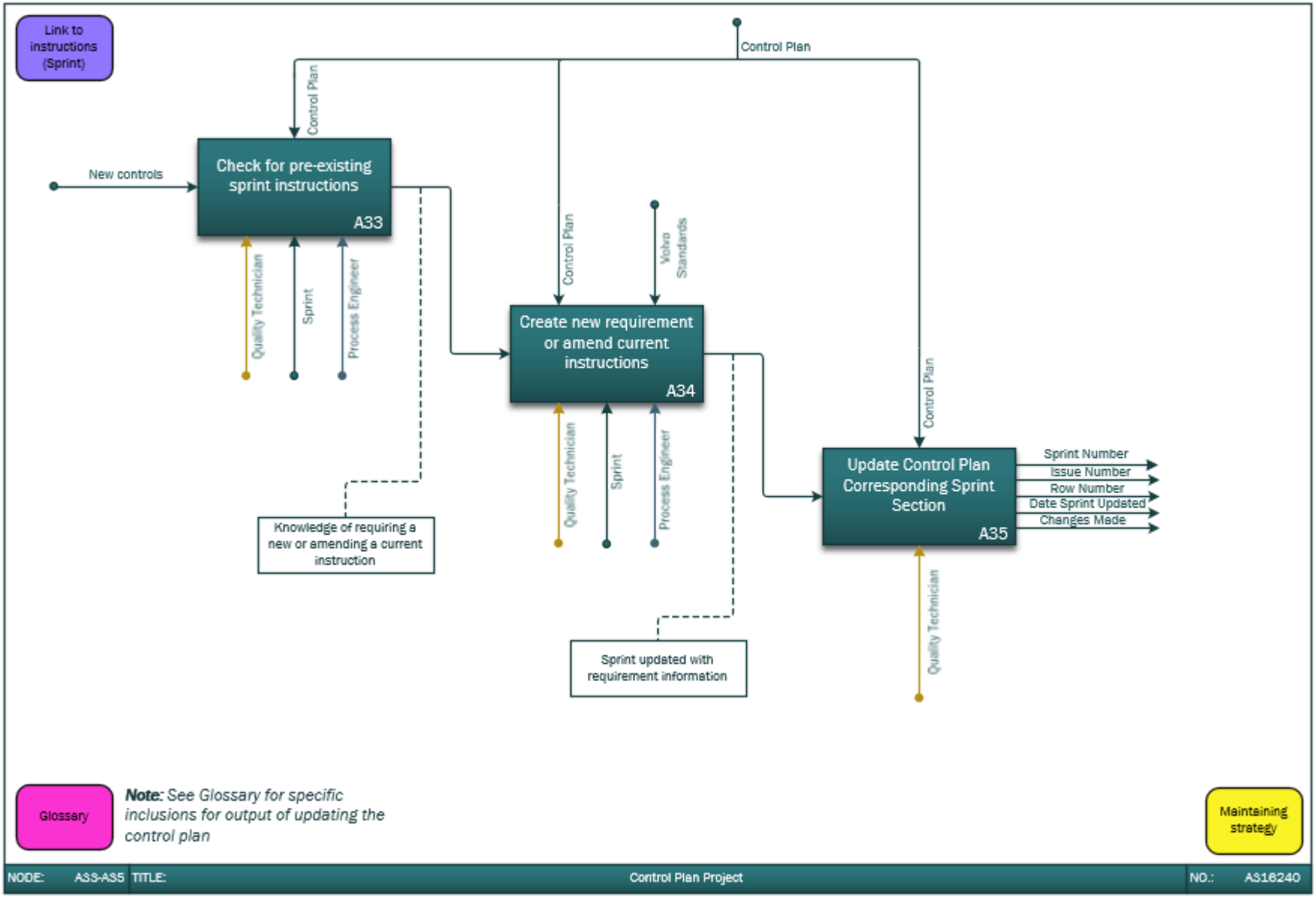


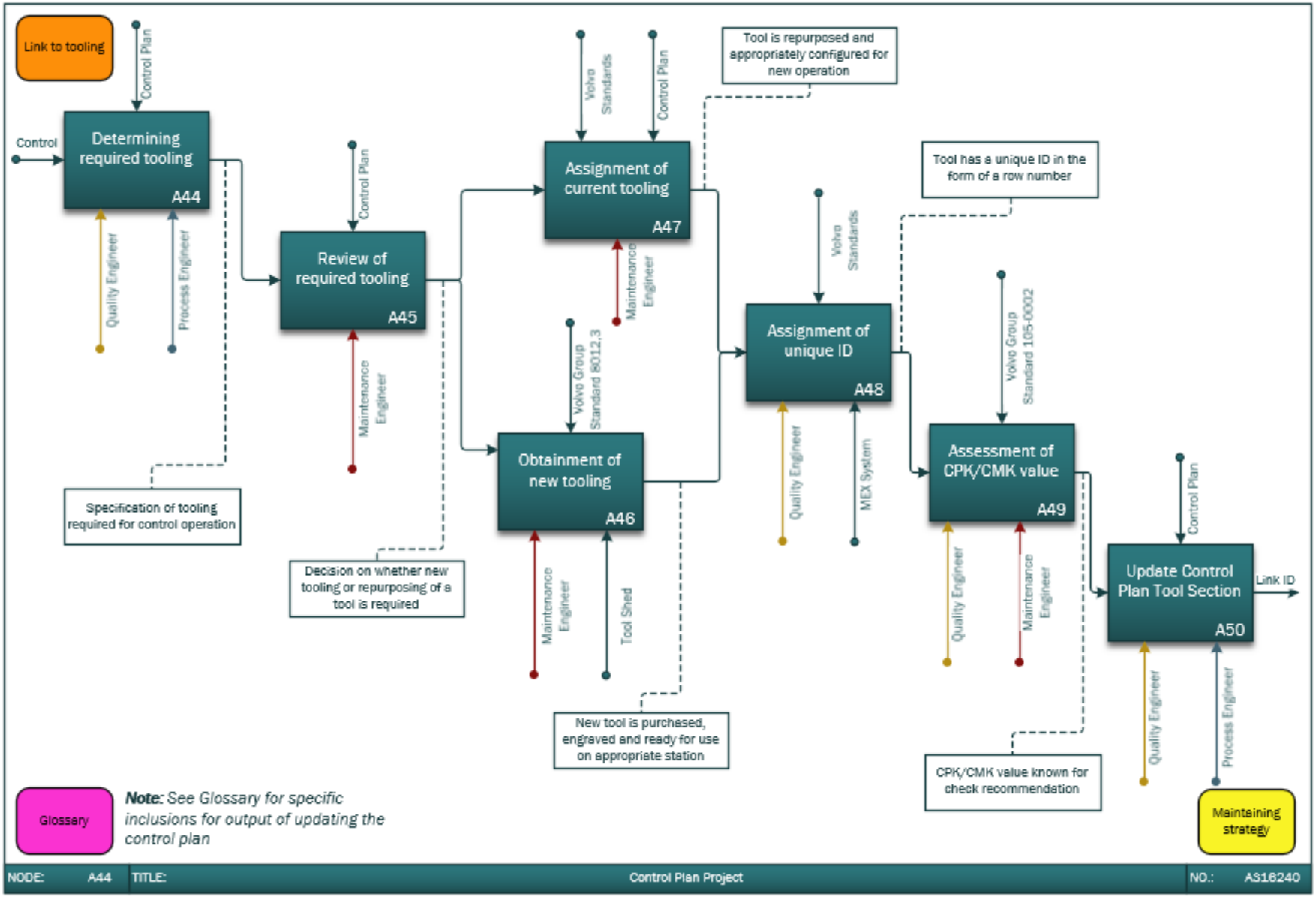

Maintaining strategy
Volvo Group Standard 105-0007
Control Plan
DCN
Analysis Result
Specify requirement to be changed/added
A1
A11-A21
Quality Engineer
Altered/Added requirement
Factory Layout
Specify factory link for control
A2
A22-A24
Production Line
Quality Engineer
Location of requirement
Volvo Group Standard 100-0009
Specify instruction for control
A3
A33-A35
Process Engineering
Quality Technicians
Instructions for requirement
Volvo Group Standard 8012,3
Specify tooling for instruction
A4
A44-A50
Quality Engineer
Maintenance Engineer
Tooling to fulfil requirement
Maintenance Department
Volvo Standards
Control Plan Template
Review control
A5
A55-A59
Quality Department
Agreed updated controls
Control Plan
Volvo Standards
Implementation of new controls
A6
A66
New controls
Quality Inspectors
Production line
Production and Process Department
Glossary
Note: See Glossary for specific inclusions for output of updating the control plan
Project Overview
NODE: A1-A5
TITLE: Control Plan Project
NO.: AS16240

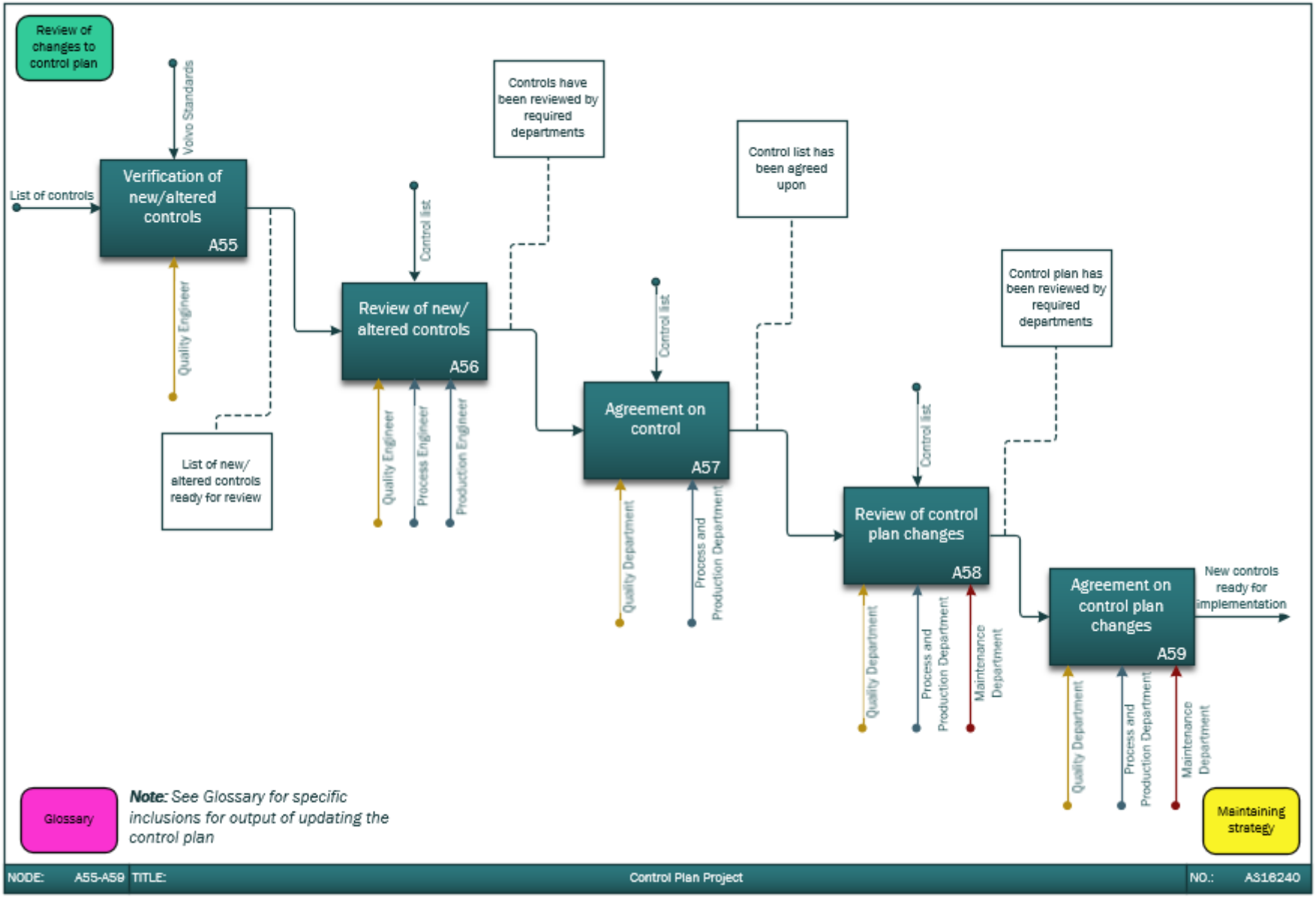

Change due to Introblock
Introblock documentation
Introblock information
Review the information changing in the next introblock
A11
Quality Engineer
Introblock project team
Knowledge of introblock changes
KOLA
Sort through DCNs created from introblock
A12
Quality Engineer
List of DCNs that involve updating of regulatory documentation
KOLA
Volvo Group Standard 105-0007
Highlight criticality in the requirements
A13
Quality Engineer
List of specifications that are required to go into the control plan
Drawings
Technical Regulations
TechNotes
Assembly Instructions
Installation Requirements
Update Control Plan General section
A14
Reference Number
Date Reference Number
Reference Changes
Date CP Updated
Changes Made
Quality Engineer
Drawings
Technical Regulations
TechNotes
Assembly Instructions
Installation Requirements
Update Control Plan Operations section
A15
Applicable Variant
Overview
Requirement
Quality Engineer
Glossary
Note: See Glossary for specific inclusions for output of updating the control plan
Change due to Quis
Maintaining strategy
NODE: A11-A15
TITLE: Control Plan Project
NO.: AS16240

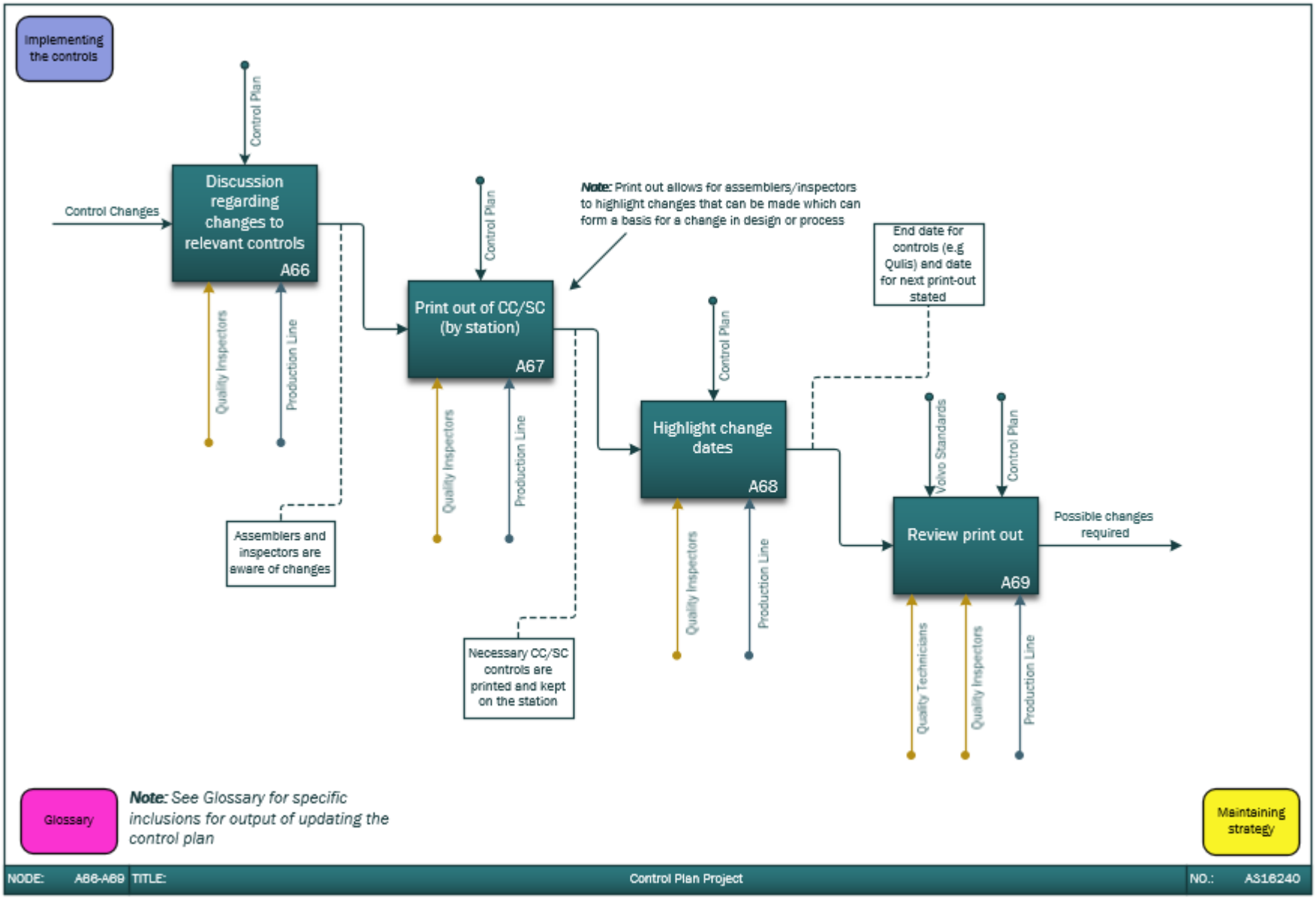

Change due to Qulis
Engineering Documents
Qulis Case Report (Production)
Qulis Case Report (Audit)
Review the Qulis Cases that are raised
A16
Quality Engineer
Process Engineer
Production
List of Qulis Cases that have a change in control as a solution strategy
Qulis Report
Highlight control to be put in place
A17
Quality Engineer
List of control to be added into the control plan
Volvo Standards
Qulis Report
Determine time period for control implementation
A18
Quality Engineer
Provide timeline for control implementation (from-to dates)
Qulis Report
Update Control Plan General section
A19
Quality Engineer
Reference Number
Date CP Updated
Changes Made
Format excel file to highlight when control is in effect
Implement a deadline for the control
A21
Quality Engineer
Date Reference Updated
Reference Changes
Qulis Report
Update Control Plan Operations section
A20
Quality Engineer
Applicable Variant
Overview
Requirement
Glossary
Note: See Glossary for specific inclusions for output of updating the control plan
Change due to Introblock
Maintaining strategy
NODE: A16-A21
TITLE: Control Plan Project
NO.: AS16240

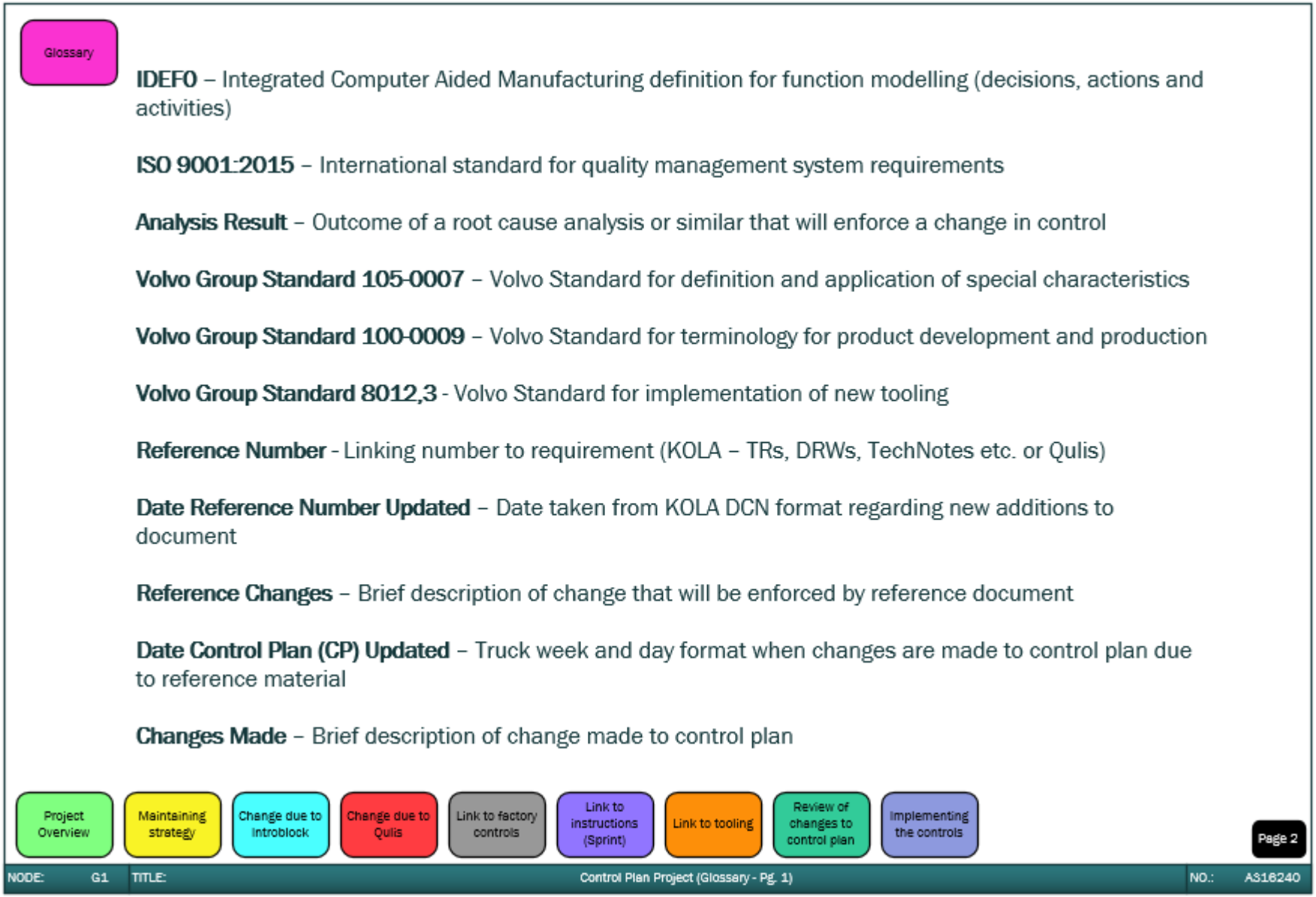

Link into factory controls
Factory Layout
Control Plan
Use factory layout to determine station for control
A22
Quality Engineer
Control Plan being updated
Control Plan
Verify correct station is recorded for control
A23
Quality Technicians
Quality Inspectors
Production Line
Assignment of station number to control in control plan based off factory layout document
Control Plan
Update Control Plan Operations section
A24
Station Number
Quality Engineer
Verification of station number for control is correct
Glossary
Note: See Glossary for specific inclusions for output of updating the control plan
Maintaining strategy
NODE: A22-A24
TITLE: Control Plan Project
NO.: AS16240

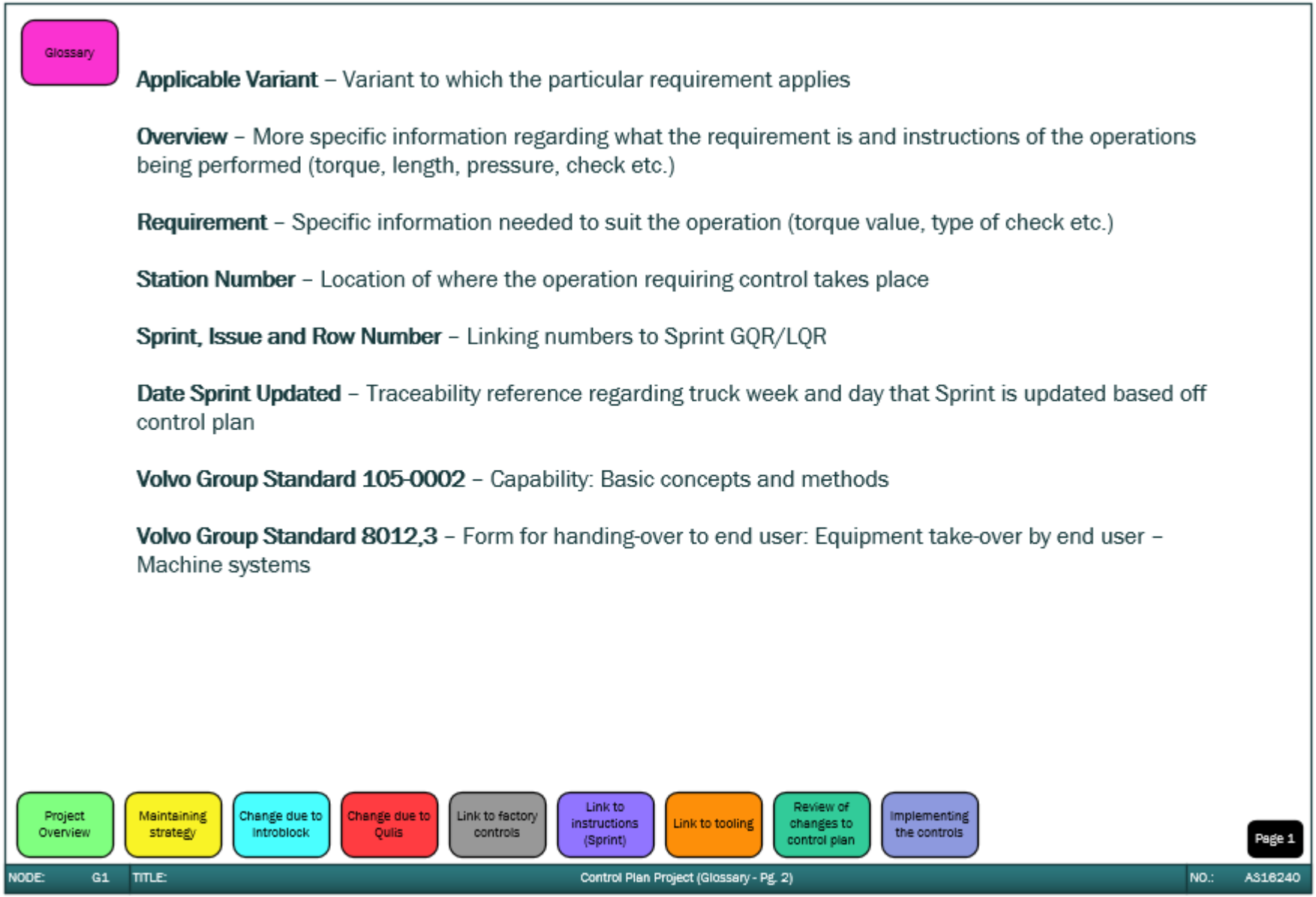

Link to instructions (Sprint)
Control Plan
Control Plan
New controls
Check for pre-existing sprint instructions
A33
Quality Technician
Sprint
Process Engineer
Control Plan
Volvo Standards
Create new requirement or amend current instructions
A34
Quality Technician
Sprint
Process Engineer
Control Plan
Update Control Plan Corresponding Sprint Section
A35
Sprint Number
Issue Number
Row Number
Date Sprint Updated
Changes Made
Quality Technician
Knowledge of requiring a new or amending a current instruction
Sprint updated with requirement information
Glossary
Note: See Glossary for specific inclusions for output of updating the control plan
Maintaining strategy
NODE: A33-A35 TITLE: Control Plan Project NO.: AS16240


Link to tooling
Control Plan
Control
Determining required tooling
A44
Quality Engineer
Process Engineer
Specification of tooling required for control operation
Review of required tooling
A45
Control Plan
Maintenance Engineer
Decision on whether new tooling or repurposing of a tool is required
Volvo Standards
Control Plan
Assignment of current tooling
A47
Maintenance Engineer
Tool is repurposed and appropriately configured for new operation
Volvo Group Standard 8012,3
Obtainment of new tooling
A46
Maintenance Engineer
Tool Shed
New tool is purchased, engraved and ready for use on appropriate station
Volvo Standards
Assignment of unique ID
A48
Quality Engineer
MEX System
Tool has a unique ID in the form of a row number
Volvo Group Standard 105-0002
Assessment of CPK/CMK value
A49
Quality Engineer
Maintenance Engineer
CPK/CMK value known for check recommendation
Control Plan
Update Control Plan Tool Section
A50
Link ID
Quality Engineer
Process Engineer
Maintaining strategy
Glossary
Note: See Glossary for specific inclusions for output of updating the control plan
NODE: A44
TITLE: Control Plan Project
NO.: AS16240


Review of changes to control plan
Volvo Standards
List of controls
Verification of new/altered controls
A55
Quality Engineer
List of new/ altered controls ready for review
Controls have been reviewed by required departments
Control list
Review of new/ altered controls
A56
Quality Engineer
Process Engineer
Production Engineer
Control list
Agreement on control
A57
Quality Department
Process and Production Department
Control list has been agreed upon
Control list
Review of control plan changes
A58
Quality Department
Process and Production Department
Maintenance Department
Control plan has been reviewed by required departments
Agreement on control plan changes
A59
Quality Department
Process and Production Department
Maintenance Department
New controls ready for implementation
Glossary
Note: See Glossary for specific inclusions for output of updating the control plan
Maintaining strategy
NODE: A55-A59
TITLE: Control Plan Project
NO.: AS16240


Implementing the controls
Control Plan
Control Changes
Discussion regarding changes to relevant controls
A66
Quality Inspectors
Production Line
Assemblers and inspectors are aware of changes
Control Plan
Print out of CC/SC (by station)
A67
Quality Inspectors
Production Line
Necessary CC/SC controls are printed and kept on the station
Note: Print out allows for assemblers/inspectors to highlight changes that can be made which can form a basis for a change in design or process
Control Plan
Highlight change dates
A68
Quality Inspectors
Production Line
End date for controls (e.g Qulis) and date for next print-out stated
Volvo Standards
Control Plan
Review print out
A69
Possible changes required
Quality Technicians
Quality Inspectors
Production Line
Glossary
Note: See Glossary for specific inclusions for output of updating the control plan
Maintaining strategy
NODE: A66-A69
TITLE: Control Plan Project
NO.: AS16240


Glossary
IDEF0 – Integrated Computer Aided Manufacturing definition for function modelling (decisions, actions and activities)
ISO 9001:2015 – International standard for quality management system requirements
Analysis Result – Outcome of a root cause analysis or similar that will enforce a change in control
Volvo Group Standard 105-0007 – Volvo Standard for definition and application of special characteristics
Volvo Group Standard 100-0009 – Volvo Standard for terminology for product development and production
Volvo Group Standard 8012,3 - Volvo Standard for implementation of new tooling
Reference Number - Linking number to requirement (KOLA – TRs, DRWs, TechNotes etc. or Qulis)
Date Reference Number Updated – Date taken from KOLA DCN format regarding new additions to document
Reference Changes – Brief description of change that will be enforced by reference document
Date Control Plan (CP) Updated – Truck week and day format when changes are made to control plan due to reference material
Changes Made – Brief description of change made to control plan
Project Overview
Maintaining strategy
Change due to Introblock
Change due to Qulis
Link to factory controls
Link to instructions (Sprint)
Link to tooling
Review of changes to control plan
Implementing the controls
Page 2
NODE: G1
TITLE: Control Plan Project (Glossary - Pg. 1)
NO.: AS16240


Glossary
Applicable Variant – Variant to which the particular requirement applies
Overview – More specific information regarding what the requirement is and instructions of the operations being performed (torque, length, pressure, check etc.)
Requirement – Specific information needed to suit the operation (torque value, type of check etc.)
Station Number – Location of where the operation requiring control takes place
Sprint, Issue and Row Number – Linking numbers to Sprint GQR/LQR
Date Sprint Updated – Traceability reference regarding truck week and day that Sprint is updated based off control plan
Volvo Group Standard 105-0002 – Capability: Basic concepts and methods
Volvo Group Standard 8012,3 – Form for handing-over to end user: Equipment take-over by end user – Machine systems
Project Overview
Maintaining strategy
Change due to Introblock
Change due to Qulis
Link to factory controls
Link to instructions (Sprint)
Link to tooling
Review of changes to control plan
Implementing the controls
Page 1
NODE: G1
TITLE: Control Plan Project (Glossary - Pg. 2)
NO.: AS16240

8.7 Appendix F: Meeting Minutes

Location: VTA Wacol GTO Quality
Date: 14/02/2019
Time: 11:30 – 12:30
Facilitators: Joshua Newman

Attendees Joshua Newman
Michael Miglionico
Henrik Holm
Steven Odgaard

Agenda Items

1. Tooling registry
    a. What is included in it?
        i. All tooling information is on a MEX system
            - System that is updated and use as reference to tooling in use
        ii. Export to an excel document
        iii. Includes:
            - Calibration information – when calibration is due, what the calibration is
            - Maintenance information – when maintenance is due, lifecycle of tool when it requires replacing etc.
            - Location information – station where tool is supposed to be used
            - Backup information - when available, tooling that is to be used when primary one fails
    b. How is it updated?
        i. Should follow ISO document that was created
            - New tool is purchased
            - Requirements specified
            - Given to maintenance
                - Added to system
                - Engraved with settings
            - Placed on station where it should stay and be used
        ii. When requiring replacement system is kept up-to-date showing which tool is replaced and which tool is replacing it

2. Control plan linkage
    a. Have spoken with quality team regarding what is wanted from the quality POV
        i. Not specific tool ID due to issues with tools being moved around
        ii. Needs to be minimal but still have some form of link to the tool registry
    b. What is wanted from Michael and Henrik?
        i. Henrik
            - Control plan to have everything included all in the one document
            - Everything from old control plan + back up tool column
            - Addition of CPK/CMK value
        ii. Michael
            - To be able to look at control plan then a given tool and see what is the requirement to put into the tool and where the tool is going
            - Control plan acting as a governing body to relate to the tool registry
            - Addition of CPK/CMK value
3. Current Issues
    a. Tooling is moved from station to station due to not enough resources
        i. Loses traceability
        ii. Should be able to go to a station and have a list of tools and they be there, this isn't the case at the moment
    b. People aren't following the ISO document and there are tools on the line that are registered at all
        i. Loses traceability
    c. Overarching issue is not following processes leading to traceability issues
        i. Isn't part of scope
        ii. Have to have a process that is set up and instructions put in place so when issues regarding following processes are dealt with the process can be easily followed

Action Items	Owner(s)	Deadline	Status
Meet with Michael to look at MEX system	Joshua Newman	-	In progress
Find excel file from exported MEX data	Michael Miglionico	-	In progress
Bring up suggestions in quality meeting	Joshua Newman	-	In progress

FOLLOW-UP #1 MEETING MINUTES

Location: VTA Wacol GTO Quality
Date: 25/01/2019
Time: 10:00 – 11:00
Facilitators: Edney Ferreira
Alessandro Ferreira

Attendees Edney Ferreira
Alessandro Ferreira
Joshua Newman

Agenda Items

1. **Current Control Plan**
   a. Who can I speak to regarding the old control plan – explanation of where data comes from
      (a) Arnold Horne – good place to start – has been updating on the side
   b. Which format to use for control plan (current one in Volvo/Mack files or CP-format from the training PowerPoint)?
      (a) Compare the two determining positives and negatives – possible third option if found something that would work better – proposal of which to use
   c. Is the optimal outcome the automation of the quality control plan however, should begin with the forming of the quality control plan ranging from engineering -> customer and the process involved? – Configuration management (process throughout the organization – baselines → Activities → People = Identification → Control → Status accounting → Verification and Audit)
      (a) Primary objective is to update and form methodology to keep updated
      (b) Keep suggest possible ways of automating but should be a secondary objective (not likely to happen within 6 months)
2. **Project Steering Model**
   a. Delimitations – looking at ways to improve current quality testing/processes
      (a) Shouldn't be included as part of this project but can be kept in mind if processes are seen throughout project that could be improved and how (suggestions)
   b. Interactions with other projects
   c. Feedback from Directive Draft
      (a) New project name (not automating)
      (b) Elaborate on project objectives illustrating how objectives will be measured/quantified
      (c) Resource plan – change to total hours rather than weekly (used as cost to the company)
         (i) Daily meeting with quality process technicians starting week after induction – 6:30 – Meeting rooms

(d) Communication plan – add meeting with steering committee, meeting with Jim (international manufacturing quality) – add meeting with quality process technicians

3. **Expectations**

a. After induction, update current plan from in decided format whilst working through feasibility study (i.e. update plan concurrently with formation of new method)?

(a) Yes, updating the plan should be first thought with feasibility study done concurrently

b. Organize meeting time with stakeholder for stakeholder analysis (influence and approval)?

(a) Lee and Patrik forming Steering Committee so interactions with them will be had in meetings throughout duration of the project

(b) Having daily meetings with process technicians

4. **Other questions**

a. Access to SPRINT and Microsoft Project

(a) Access to Microsoft Project and SPRINT has been approved

b. Possibility to spend some time with inspectors on the production line

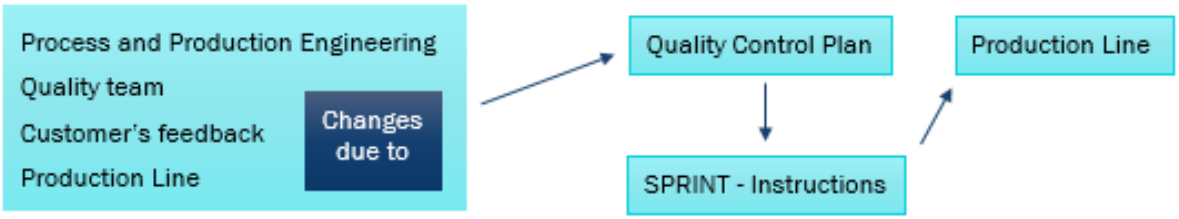
c. Not only looking at engineering changes but also changes brought forward by:

(a) Engineering (Process and production)

(b) Quality team (on the production line and auditors)

(c) Customers

(d) Production Line – calibration (what's on SPRINT and what's on the production line)



Action Items	Owner(s)	Deadline	Status
Project Directive	Joshua Newman	01/02/2019	Completed
Send through Project Directive + Appendices to Steering Committee + Edney and Alessandro	Joshua Newman	30/01/2019	Completed
Forming Steering Committee	Edney Ferreira	-	Completed
Induction training	Joshua Newman	01/02/2019	Completed